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Drawn by Charles Dixon.

THE BRITISH SUPERDREADNOUGHT "IRON DUKE" IN ACTION.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

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Science in Peace and in War

It is inevitable that new discoveries in physics and chemistry should be promptly seized by military men and applied in devising death-dealing engines of appalling power. But is it necessarily inevitable that science should be more systematically applied, on the whole, to increasing the efficiency of high-powered guns than to mitigating the evils of disease and to better the general lot of humanity?

Ten years have passed since the Russian-Japanese war was fought. In that decade it is safe to say that more costly experimental investigation has been conducted to increase the efficacy of guns and explosives than to eradicate any one of a dozen human diseases for which there is at present no cure. The art of war is as old as the art of agriculture. But battleships are so rapidly improved that in less than five years the most powerful dreadnought of her day becomes a third rate fighting machine. Can as much be said of harvesting machinery?

Despite our Carnegie Institutions, our Rockefeller Institutes, our Pasteur Institutes, despite all the laboratory work done by the universities of the world, it is safe to say that more money is spent to discover new and more terrible ways of destroying human life than to preserve it. Not so long ago, the old battleship "Texas" was taken to Hampton Roads and used as a target in order to test the destructive powers of our latest battleship guns. Before that Great Britain had conducted similar experiments with the "Belle Isle." German officers with an academic turn of mind have tested Roman catapults, old guns, and the like in order to determine what progress was made in artillery from ancient days to Napoleon's time, thus completing the history of guns in a way that must cause the historians of science to sigh with admiration and envy. In 1883 and 1886 tests were made during which Gruson turrets were subjected to modern artillery fire, experiments that cost a fortune, not only in ammunition expended, but in the actual destruction of test objects. The legislatures of the world must be implored to grant comparatively small sums for conducting research which will ultimately result in bettering social conditions. A mere pittance is granted to a man like Luther Burbank, who performs the miracle of creating plants more useful to mankind than the vegetation of nature; but a prince's ransom is set aside to conduct a scientific investigation into the effect of a new explosive at a range of five miles. Advocates of eugenics do their best to arouse the public conscience to the need of race improvement, to the folly of permitting the insane, the epileptic, the socially unfit to reproduce their own kind; but the armies of the world take the flower of humanity and leave behind only human dregs.

No doubt there is a good psychological reason for this frightful anomaly. But when this hugest of wars is over, when we have counted the dead and wounded, when we have reckoned the dreadful cost in money of the millions of rounds fired, when we have tolled off the brilliant intellects that have been blotted out and that could ill be spared, and then reckon up what we have left in money and human material to continue the constructive work, so unnecessarily interrupted, will the **anomaly** be perpetuated? Will Reichstags, congresses, and parliaments grudgingly allot $20,000 to discover the cause of some new mysterious wheat blight and $100,000 to discover a better kind of bomb that may be dropped from a dirigible airship?

A Real Test of the Flying Machine in War

If ever there was any doubt at all of the efficacy of the flying machine in war, surely the terse reports of Sir John French must have dispelled it. "One of the features of the campaign on our side has been the success of the Royal Flying Corps," writes Sir John. "In regard to the collection of information, it is impossible either to award too much praise to our aviators for the way they have carried out their duties, or to overestimate the value of the intelligence collected, more especially during the recent advance."

Sir John does not say so, but it may safely be surmised that the retreat after the battle of Mons might have been an utter rout had it not been for the air scout. With the watchful eyes in the air, it seems to have been a comparatively easy matter for the Allies to concentrate troops where they were most needed in order to permit the main body to retire in good order and take up a new position.

During a period of twenty days up to the tenth of September, Sir John French tells us, a daily average of more than nine reconnaissance flights of over one hundred miles each was maintained. The information obtained was so precise and so valuable that Field Marshal Lord Kitchener conveyed his thanks for the services rendered by the English Flying Corps.

The present conflict is not the first in which the flying machine has figured, but it is the first in which there have been real aerial encounters. Military officers prophesied that the air scout would not be permitted to reconnoiter with impunity. In the present war we have heard of at least a dozen aviators who were thwarted in their attempts at scouting by the armed aeroplanes of their opponents. On this point Sir John French's comments are illuminating. "The tactics adopted for dealing with hostile aircraft are to attack them instantly with one or more British machines," he tells us. "This has been so far successful that in five cases German pilots or observers have been shot while in the air and their machines brought to ground. As a consequence the British Flying Corps has succeeded in establishing an individual ascendency which is as serviceable to us as it is damaging to the enemy. How far it is due to this cause it is not possible at present to ascertain definitely, but the fact remains that the enemy have recently become much less enterprising in their flights. Something in the direction of the mastery of the air already has been gained in pursuance of the principle that the main object of military aviators is the collection of information."

If this means anything at all, it means that the command of the air must henceforth be attained before a modern general can hope to win a battle. Until the last air scout of his enemy has been shot, his own forces and those of the enemy must fight until physical exhaustion sets in and a point is reached where it is impossible to draw upon fresh troops. Thus may be explained the alternate advances and retreats of both sides in the present war. In the last analysis victory or defeat would seem to hinge upon the presence or absence of aerial scouts.

An American Dyestuff Industry

Ninety per cent of the dyestuffs consumed upon the world's market are manufactured in Germany or from coal-tar products made in Germany. Now that the supply to this country is cut off by the European war, an outcry is raised by a certain section of the consumers, the textile dyers, that we should have had a complete domestic dyestuff industry. From the standpoint of the consumers such an attitude seems natural and justified.

But the matter looks somewhat different from the point of view of the would-be producers. It is all very well for the consumers to say to the chemical manufacturers: "You ought to make dyestuffs; this country should not be dependent on Germany; the American chemist should prove himself the equal of his German rival." All this sounds as if a dyestuff industry should be established in this country from patriotic or philanthropic motives. In practice the motive for launching a commercial enterprise is the perhaps less poetic, but rather more practical desire to earn dividends. Whatever the *consumer* of dyestuffs may think about it, the prospective *producer* asks first and foremost: What profit is there in the proposed industry?

This is a plain question, and in reply to it let us begin by the plainest of all observations: The total imports of coal-tar dyestuffs to this country in recent times are valued at about $10,500,000 per annum. This total is distributed over some 900 odd dyes, so that the gross value of any one dye consumed per annum is on an average something more than $11,500. Hardly a very tempting bait for the would-be producer, as publicly stated more than ten years ago. The fact is, the economic importance of the dyestuff industry has been much exaggerated. From the nature of things it must necessarily be localized, and there is just about enough of it from one country. That country, for economic (historical) reasons, is Germany, and the attempt completely to transplant the industry at short notice would never for a moment be undertaken by anyone conversant with the technical and commercial peculiarities of the manufacture of coal tar dyes.

He knows that the by-product problems peculiar to organic chemistry, which have to be met therein, are paramount and the real key to the situation. Organic reactions are much more complicated than those of inorganic chemistry. They rarely take one single and undivided course. This state of affairs greatly complicates the problem of finding an outlet for by-products, with the result that the modern dyestuff industry of Germany is one interlacing system, one great mosaic of interdependent processes and products, only a few of them of large dimensions, but all of them to-day of far-reaching effect. This necessitates not only the careful organization of each manufacturing unit, but often an exchange between separate units of some of their products. It must be remembered that the German dyestuffs industry as it stands to-day is the result of thirty-six years of untiring manufacturing and merchandising effort and development.

One influence which has been thought to be largely responsible for the absence of a domestic industry is our patent system. It has been urged that a working clause should be introduced, which would compel foreign owners of American patents to manufacture in this country. It is more than probable that those who bank any hopes on such a step as this are entertaining a fond illusion. England, Belgium, and France have had such working clauses for many years, yet they have no real dyestuffs industry. Nor is the reason far to seek. Completely fulfilling such provision without establishing a real industry has been the actual result. As an illustration, assume magenta (hydrochloride) to be patented here. The patentee sends to this country magenta *base*, which is *not* the subject of the patent. By the simple addition of hydrochloric acid thereto the magenta salt which *is* the subject of the patent is then prepared here; the working clause is fully lived up to, but no industry has been established.

If any further evidence is needed to show that the patent situation is not the cause of the German monopoly in dyestuffs, some figures collected by Dr. Hesse, the well-known chemical expert and our foremost authority on dyestuffs, speak convincingly. According to Dr. Hesse, out of a total of 921 coal-tar dyes, 467 have never been patented in the United States, and the patents on 239 further dyestuffs have expired. Only 215 of these dyes are at present protected by patents. Of those dyes which we are at liberty to manufacture only about 10 per cent are actually made here, and these very largely from imported coal-tar products not themselves dyes.

Since it seems established that a remedy is not to be found in amending our patent laws, we must look elsewhere for relief. It has repeatedly been suggested that an appropriate increase in our import duties would give the needed assistance to domestic producers to enable them to compete with the Germans in spite of all the obstacles which we have discussed. Let us apply the test of actual figures to this question. With an average annual importation of about $6,000,000 worth of coal-tar dyes in the last thirty years, we have a total importation of $180,000,000 during that period. Assuming that duties had been 10 per cent higher than was actually the case, this means that a total of $18,000,000 would have been paid as an insurance premium against the possible event of a war such as that which is now disturbing commerce. It would take at least a three years' war before this total premium alone, making no allowance whatever for interest, had been repaid by the home industry which we are supposing to have been established by the aid of the additional duty.

Substances for Paint.—The French government prohibits the use of red lead and white lead, having accorded a lapse of time which expired on July 31st, 1914. Zinc white will now replace white lead, and it is thought that red lead can be replaced by oxide of iron, although the latter is not so good. But it appears that graphite used with linseed oil will protect iron perfectly from rusting, and is much less expensive than lead or iron paint. Owing to the extensive use of graphite for many purposes, the natural product no longer suffices, but fortunately the new electric furnace processes come in to make up the deficiency.

Science

Prof. Roentgen Gives His Medal to the Red Cross.—A Berlin paper states that Prof. Roentgen does not care to retain the English medal, presented to him by the Royal Society, in recognition of his discovery of the X-ray, and has therefore given it to the Red Cross. The medal contains $250 worth of gold.

Automatic Light for Bromide Printing.—When making prints on bromide paper it is required to put on red light for loading the paper under the negative, then white light for the exposure, after which red light is again needed. A French automatic device simplifies these operations, where electric light is used. A pointer is placed on the dial at the number of seconds exposure, then the operator pulls upon a chain and the red light goes out and white light comes on for the exposure for the right number of seconds, then the red light is automatically thrown on and remains lit while the operator charges the paper for the next exposure, or until the chain is again pulled, and so on. The device is useful for making many exposures from the same negative.

The Need of a Weather Bureau in China is emphasized by Mr. C. D. Jameson in his report to the American Red Cross on the measures which his personal observations in China indicate should be adopted to ameliorate the flood and famine conditions of that country. There are at present practically no rainfall statistics for the river basins most subject to floods, much less any organization for flood prediction. Torrential rains sometimes occur in this region. In June, 1910, a local downpour in the vicinity of Sze-chow, lasting some 42 hours, is estimated to have amounted to 24 inches. The unofficial meteorological service of Zikawei Observatory, extending along the coast and up the Yangtse valley, is the nearest approach to a national weather bureau yet existing in China.

New Flash Light Powder.—Flash light powders for photographic use are generally made up of magnesium combined with a substance rich in oxygen such as chlorate of potash, but the great drawback of such powders is that they give rise to considerable smoke or fumes. Efforts made by European inventors to find a photographic powder that gives but little smoke have now proved successful, and the new "Excelsior" compound uses magnesium and oxygen-bearing substances coming from the rare earths. For this purpose, peroxide of lanthanium was chosen, and to it are added substances analogous to what are found in Welsbach lamp mantles. The whole forms a powder which is claimed to give an excellent flash light and has but one tenth the amount of smoke. The small amount of fumes dissipates almost at once in this case.

"Karluk" Survivors Reach Nome.—Word has been received, from Nome, of the arrival there of the United States revenue cutter "Bear," with eleven survivors of the Stefánsson Canadian exploring party. After their ship, the "Karluk," was crushed in the ice at Herald Island, last January, the survivors of that disaster camped on the ice for some weeks, and finally reached Wrangell Island in March, from whence this party was recently rescued by a power whaler, and transferred to the "Bear." Twelve of the original party are missing or dead, as a result of exposure, including Henri Beauchat, anthropologist; George Stewart Mallock, geologist; James Murray, of Glasgow, ocean current specialist; and Dr. A. Forbes-McKay, surgeon, the two latter having been with Shackleton in 1907–9. Besides these, Stefánsson, who had left the ship with four others on a hunting trip before it was crushed, started on a side exploring expedition to Banks Land five months ago, and has not been heard from since.

The Deluge Preceded the Fall of Man.—According to a translation of a recently deciphered inscription on one of the Sumerian tablets, Prof. Langdon, of Jesus College, Oxford, says the deluge preceded the fall of man. The tablet, which has been almost completely restored, contains six finely written columns of about 240 lines, most of which are intact. It begins by describing the land of primeval bliss, which it locates at Dilmun, an island in the Persian Gulf. "In this paradise dwelled mankind, whom Nintud, the creatress, with the help of Enlil had created. After the Deluge, this King is called Tagtug, the Divine. And this Tagtug lives in a garden, is himself a gardener, and the wise Enki reveals unto him wisdom. The Greek historians, too, preserve this legend in the story of Oannes, who rose from the Persian Gulf to teach men wisdom in primeval times. And so Tagtug, as in the Hebrew history of Noah, plants a garden, names the trees and plants, and is permitted to eat of all but the cassia tree, an herb of healing *par excellence*. Of this plant Tagtug was not to eat, for thereby he would attain eternal life. Mankind until this time possessed extreme longevity, but not immortality. Tagtug, on his own initiative, takes and eats. He is cursed by Nintud and becomes a prey to disease and ordinary mortality. Thus in the original Sumerian story Noah, the survivor of the flood, is the one who eats from the tree of life. No woman is concerned in this disobedience which resulted in our loss of perfect health, peace and countless years."

Automobile

New York and Chicago Motor Show Dates Set.—As heretofore, the New York annual automobile and accessory show will be held in January, the date being the week of 2nd–9th. Grand Central Palace will be used. The Chicago show, which is the only other national affair, is to be held January 23rd–30th.

German Benzol Increasing.—That Germany is not placing as great reliance upon gasoline, or as it is styled abroad, petrol, as heretofore, in indicated by the fact that during the past few years the production of benzol has increased markedly. For instance, whereas the output during 1909 was but 29,470 tons, the figures for 1910, 1911 and 1912 are 42,767, 53,941 and 60,401 tons, respectively. Later figures are not available.

Throwing the Headlight in Either Direction.—Alden L. McMurtry, of Sound Beach, Conn., realizing that at times it is desirable to move an automobile rearwardly as well as to the front, has provided, in patent, No. 1,105,035, a lighting system for automobiles and other vehicles which may be reversed, which lighting system may be operated to throw a powerful light to the front or rear according to the direction of movement, and this without interfering with the ordinary rear lights of the vehicle.

Paris Bans Steel-Shod Tires.—In Paris, an order recently has gone into effect prohibiting the use of steel-shod tires within the Metropolitan area, after the opening of the new year. In the meantime, vehicles so shod must proceed at what is virtually a snail's pace. As a direct result, most of the vehicles designed for metal tires have been converted already and the remaining few evidently are being worked to destruction before being withdrawn. Only a few years ago there was a considerable boom in steel-shod commercial vehicles, and the change is all the more noteworthy.

Fire Extinguishers Upon Motorcars.—It is interesting to note, particularly in view of the widespread safety first movement, that a number of the insurance companies writing fire risks upon motorcars have taken a certain means to reduce the fire hazard by agreeing to a reduction in premiums, provided carbon tetrachloride extinguishers are carried on the cars. So far no manufacturer has evidenced any inclination to include a fire extinguisher in the standard equipment, though it would seem that this might be done with profit. The reduction in the premium amounts to 15 per cent.

Skew Bevel Gears Increasing.—Although the worm gear, which has made such strides abroad, has not yet "caught on" to any great extent in America, the fact of its existence has stimulated the desire for something quieter than the ordinary bevel gear. As a result, several manufacturers have incorporated in their new products what is virtually a cross between the two. It is styled a skew bevel gear. It differs from the usual bevel gear in that the teeth are not straight and placed at right angles to the center, but are slightly curved. The result is that whatever clash there may be in a bevel gear is eliminated, the teeth rather sliding together as they do in a worm. It is further pointed out that the skew gear reduces the backlash to the minimum.

Reducing Wind Resistance.—One of the noticeable trends in the 1914 models that made their appearance last fall was the gradual increase in the use of so-called streamline bodies. For the coming year, this tendency will be even more marked. It would seem that in thus reducing the wind resistance of their products American designers are giving evidence of having learned a valuable lesson from their foreign contemporaries. The streamline body long has been appreciated abroad, where the careful reduction of wind resistance to the minimum has been well worked out. The use of smooth-sided bodies, from which abrupt angles have been eliminated, no doubt is in a measure responsible for the noteworthy fuel economy that is a feature of so many foreign cars. Another feature of motorcar construction to which much attention might be paid is the more careful distribution of weight. A careful balancing of the load would minimize skidding proclivities, equalize to a greater extent the wear on tires and improve the riding qualities.

Positively Operated Poppet Valves.—The possibilities of the springless type of poppet valve were pretty thoroughly demonstrated in some of the recent foreign road races. In fact, they worked so well that there is every probability that they will come into fairly general use in the not far distant future. The positively operated valve differs from the usual type in that the cam not only opens the valve but closes it as well. In the generally accepted type of poppet valve, the valve itself is closed by a heavy spring. It is claimed for the springless valves that a higher rate of speed is possible; that greater power naturally results and that the factor of safety is increased. With the spring-controlled valve, the piston speed is limited by the inability of the spring to close the valve before the cam has come around and started to open it again. Heavy springs and light valves have partly solved the problem, which still remains where springs are used. With the positively operated valve it is no longer the valve which limits the speed of the motor.

Inventions

Rejuvenating Old Wells.—Walter O. Snelling, of Pittsburgh, in a patent, No. 1,104,011, employs heat in treating old oil and gas wells for rejuvenating the same.

Substitution of Material in a Milking Machine.—Patent No. 1,103,974 has issued upon the invention of Knut Ivar Lindstrom, of Vibynas, Nykvarn, Sweden, for a milking machine in which the connecting tubes are made of a transparent elastic material, particularly celluloid, so the milk flowing in the tubes can be observed.

An Elihu Thomson Oil Engine.—In a patent, No. 1,105,047, Elihu Thomson, of Swampscott, Mass., for utilizing heavy oils in internal combustion engines, provides a vaporizer involving a tortuous passage in a body of resistant material, which is heated by passing an electric current through it for vaporizing purposes.

Uniting Glass in Bifocals.—Patents Nos. 1,103,961 and 1,103,962 have issued to Benjamin N. Hanna, of Pittsburgh, Pa., relating particularly to the manufacture of bifocal lenses and utilizing the principle of thermal expansion in uniting the two bodies of glass, patent No. 1,103,961 being for the method and the other patent being for the spectacle glass.

The San Francisco Branch of the Patent Office.—Commissioner Ewing announces that, in compliance with Congressional action, a branch office of the United States Patent Office has been opened at San Francisco for the purpose of issuing certificates of proprietorship, as provided in the act for such purpose relating to the Panama Pacific Exposition.

Artificial Day-light.—Herbert E. Ives, of Mount Airy, Pa., in a patent, No. 1,104,900, seeks to produce from artificial light the color effects of day-light, for use in dyeing and in surgical work where it is important to know the relative colors of tissues, by means of a goggle having color-filtering screens as specified more in detail in the patent.

Toys as Objects of Invention.—The toy famine referred to as a probable result of the effects of war upon the European toy producing centers should stimulate American production of existing forms of toys, and also the origination and invention of distinctly new toy objects. The enormous profits attributed to some very simple toys is sufficient to encourage inventive effort in such direction.

A Bottle Cleaning Process.—The following method is said to be a very good one for washing bottles which contained an oily substance, such being often very difficult to clean. It suffices to wash the bottle with very hot coffee grounds in order to remove such substances. In connection with this, it is recommended to use a solution of bichromate of potash and sulphuric acid in equal proportions, taking care to avoid contact with the skin, for such liquid is very corrosive. Rinse several times in pure water. These two methods must, of course, be used separately.

Eye-glass Improvement.—Among eye-glasses of the nose clamping kind a popular style is that in which the levers have the nose clamping jaws at the inner side of the glasses and handle-like parts projecting outwardly so they can be pressed together by the forefinger and thumb to spread the nose clamping jaws. A correspondent suggests the possibility of some practical connections leading to an operative device at the outer edges of the right lens to avoid the forwardly projecting handle portions and also avoid blurring the lenses by the fingers in operating the clamps.

An Electric Drier for the Sea-shore.—Those who sojourn at the sea-shore note the effects of the dampness on the wearing apparel, particularly in comparing the condition of garments when they return home with the condition when they reach the sea-shore. It has occurred to the writer that some form of electrical drier might be devised which could be folded and placed in a trunk, and utilized to dry out garments before packing them for the return home. The drier might also be utilized in connection with any little laundry work the ladies frequently desire to carry on in their rooms, as well as for drying out wet bathing suits.

A New Device for Protecting Crops from Hail has been installed by R. Marcillac, in the Department of Ardèche, France, and a model of it was recently exhibited at Lyons Exposition. It consists of a series of tall posts arranged in a circle around a central post. All the posts are tipped with clusters of lightning rods, grounded with metal tapes. The outer posts are connected with each other and with the central post by metal cables, bearing rows of upright metal points. The total number of these points or terminals is 12,000, and the whole network covers an area of over 9,500 square yards. This elaborate device is supposed to protect the crops growing beneath it from the fall of hailstones, on the altogether fallacious assumption that a hailstorm is the result of the electrification of the atmosphere. The same idea has led to the erection all over France of tall lightning-rods, known as "electric Niagaras," which are intended to draw the electric charge from the clouds, and thereby prevent the formation of hailstones.

Volcanic Clouds

By Immanuel Friedländer

TWO kinds of steam cloud may sometimes be seen on one and the same volcano. One kind is whitish and dissolves readily into the air; the other more or less brown or black and heavily charged with ash. Fig. 1 shows four vents of Stromboli in action, with specimens of both types of cloud. The cauliflower forms of ascending ash-laden explosion clouds are well known. These occur in nearly all great volcanic eruptions, and also often persist for a long time during comparatively quiescent periods. Fig. 2 shows the cloud over Aso-San in 1908. This vent was in an approximately uniform state of activity during the period 1906-08.

Besides the above-mentioned cauliflower forms, smoke-rings often occur, resembling those which tobacco-smokers are fond of making (Fig. 3). Probably on account of strong condensation, with resulting differences in refraction, luminous rings are sometimes seen in violent explosive eruptions; a phenomenon which has hitherto been observed only by Perret. Their appearance is presumably dependent upon the sun, the point of eruption and the observer being in approximately the same vertical plane.* In Fig. 4 the rings were drawn on the photograph by Perret (who took this picture, as well as Figs. 1 and 2), as they were not bright enough to impress their image on the photographic plate.

Dust clouds, due to little atmospheric vortices, very often occur on volcanoes, especially under strong insolation. These small dust-whirls have, strictly speaking, little to do with volcanic phenomena, and are only mentioned here because they are very frequent on dusty volcanic summits and are easily mistaken for fumaroles. Moreover, small or large landslips, giving rise to avalanches of stones or dust, often fling up whirling clouds of dust which are not easily distinguished from ash-laden explosion clouds. After the great outbreak of Vesuvius in 1906 such dust clouds were repeatedly mistaken for renewals of volcanic activity. In some cases, in fact, they caused a light fall of ashes in the vicinity of the volcano, and even as far away as Resina. Very similar to the clouds of ash due to true volcanic explosions are the clouds produced by explosions occurring when large volumes of snow are buried under freshly ejected hot volcanic material. These explosions are well-known and dreaded phenomena on the slopes of Etna. In many instances patches of snow, and in others cisterns of human construction, explode under the lava. Such explosions may also occur under a layer of hot lapilli or ashes, as was observed on Mont Pelé in 1912.—Extracted and translated from *Zeitschrift für Vulkanologie.*

* Are not these more probably diffraction rings, identical with the "glory" seen around the shadow of the observer in the specter of the Brocken?—EDITOR.

Fig. 1.—Eruption of Stromboli, showing two types of steam cloud.

Fig. 2.—Cauliflower cloud. Eruption of Aso-San, 1908.

Fig. 3.—Smoke-ring. Eruption of Etna. The white spot near bottom is the sun.

Fig. 4.—Luminous diffraction rings accompanying a volcanic cloud. Observed by Perret.

A Tunnel Under the Solent, to connect the Isle of Wight with the mainland, is under consideration.

The United States Battleship "Pennsylvania" and Class

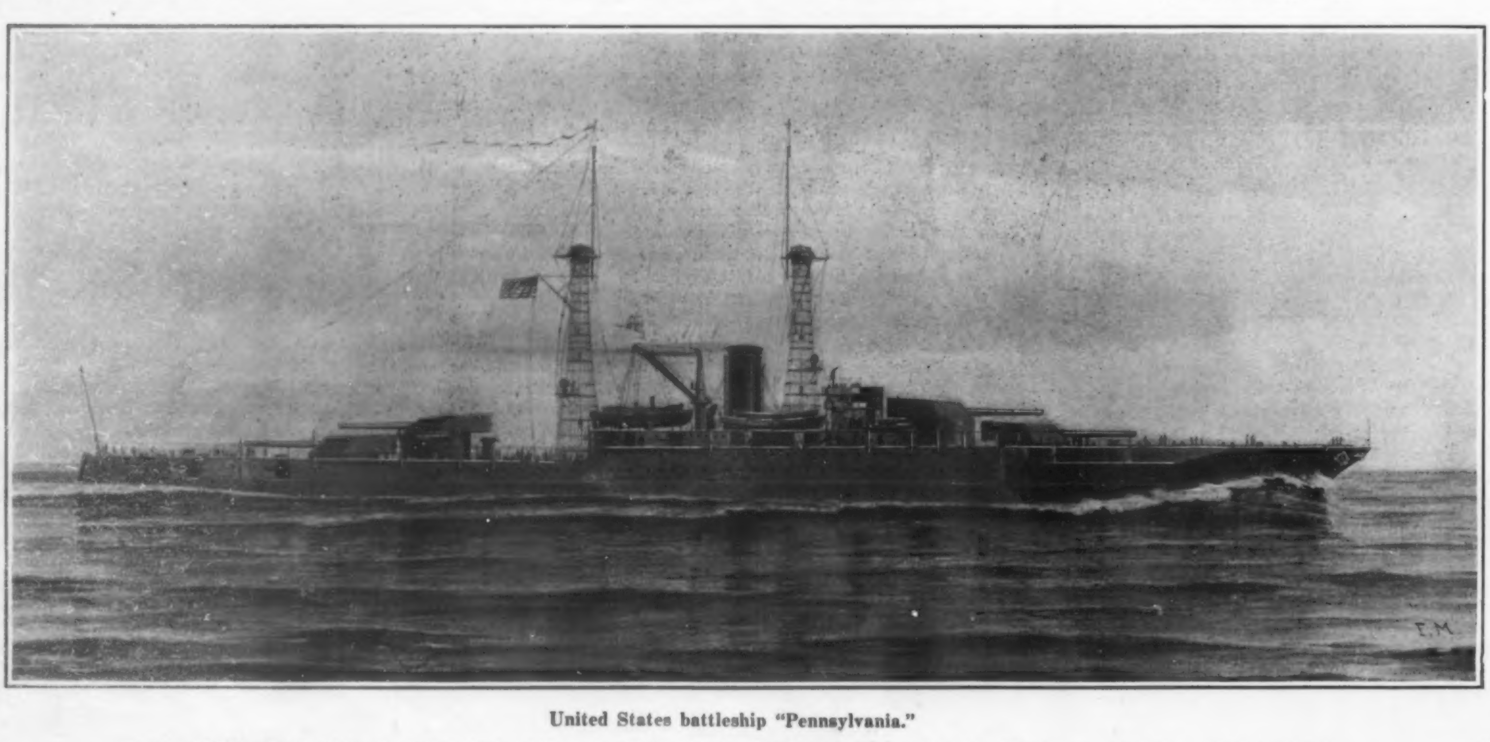
IN view of the terrific punishing power of the latest guns being mounted on the warships of foreign powers, it is the policy of our Navy Department to pay special attention to the protection of our battleships against loss or disablement by gunfire. This is very noticeable in the first of our ships to carry the three-gun turret—the "Oklahoma" and "Nevada." These ships, which are of 27,500 tons displacement and carry a main battery of ten 14-inch guns, are protected by a water-line belt of 13½ inches maximum thickness, which is 17½ feet wide. The ships are protected by 16 inches of armor on the conning tower, and the port plates of the three-gun turrets are no less than 18 inches in thickness.

The "Pennsylvania" class, of which two are now under construction, one at Newport News and the other at the Brooklyn yard, are enlarged "Oklahomas," of 4,500 tons greater displacement and mounting two additional 14-inch guns. The armor protection is heavier, and the protection against under-water attack has been amplified by the further extension of the subdivision and by the provision of improved anti-torpedo bulkheads, designed to localize the effects of the very heavy gun-cotton charges carried in the head of the latest torpedoes.

The accompanying illustration, which has been drawn from the finally approved official plans, shows the "Pennsylvania" to be a handsome ship, judged from the standpoint of modern dreadnought design. The most striking feature is that she is to carry a clipper bow, the customary ram bow giving place to the inward curve, which was such a familiar feature in the earlier transatlantic steamships. This transition was foreshadowed in our first dreadnoughts, the "Delaware" and "North Dakota," in which, with a view to giving greater buoyancy in a head sea, the deckline was flared out and carried forward well out over the ram. The destructive power of the modern gun, and the certainty that, long before it could get within ramming distance, a ship would be sunk or completely disabled, has rendered logical the abolition of the ram altogether. This not only saves a large amount of weight and much costly construction, but it makes it possible to cut away considerable deadwood forward, and conduces to a quicker answering of the helm and better all-round maneuvering power.

The "Pennsylvania" has a long forecastle deck which is carried aft to the main lattice mast. Forward on this deck are two turrets, each containing three 14-inch guns, the guns of the after turret firing above the roof

(*Concluded on page 254.*)



United States battleship "Pennsylvania."

Tons, 32,000. **Speed,** 21 knots. **Guns,** twelve 14-inch, twenty-two 5-inch. **Torpedo tubes,** four 21-inch. **Side Armor,** 14 inches. **Cost,** $15,000,000.

The Automobile of the Sea

A Water Sled That Contains Many Innovations in Hull and Propulsion

A NEW type of vessel has been produced by a Nova Scotia inventor, Albert Hickman, which promises to revolutionize water craft, and which takes the same place on the water that an automobile does on land, with all its speed and comfort.

The craft may be said to be a direct reaction from the general development of hydroplanic boats which have been used only for racing purposes, and an effort to transform the hydroplane into a successful pleasure craft. In the language of the builders, the sea sled is supposed to "carry the number of people you would carry in your car, and through ordinarily rough water, at the same speed your car would make on land, free from pounding, free from flying water, and free from danger"; and Mr. Hickman has gone to the extent of claiming that it is not a boat which he is trying to introduce, but a series of principles which are entirely at variance with those heretofore accepted in connection with craft that were to travel at speed on the water.

The first axiom in this connection is that any type of motor speed boat becomes more or less a hydroplane, that is, tends to run on the surface of the water, rather than through it; and unfortunately ordinary hydroplanes have heretofore been unsatisfactory craft for pleasure, especially in rough water.

Hydroplanes were invariably driven by screw propellers, and all embody a number of defects which may be summed up as follows: The under-water shafting with the strut bearing, etc., creates considerable resistance, is very liable to damage and makes the draft considerable; and, moreover, such an arrangement cannot be driven through weeds.

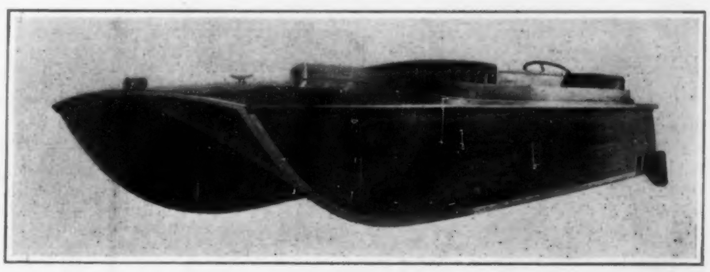
As the engine position is necessarily well aft, a screw propeller installation in a hydroplane necessitates carrying the engine shaft forward and transmitting the entire power of the engine through a gear to the propeller shaft, which is then carried aft again under the boat, involving long shafting, excessive weights, and loss of power. The screw propeller is also subject to cavitation when run at high speeds, making it decidedly inefficient.

In the development of the sea sled, the object, as far as the propeller system was concerned, was to do away with these inherent defects, and Mr. Hickman discarded the under-water screw propeller and devised the surface propeller system, and he depends for the success of the surface propeller system on a relatively high inertia of the water at speed, which is responsible for so many of the peculiarities of the hydroplane. The shaft line in a sea sled, instead of being carried forward in the boat to a gear transmission and then aft to the propeller to give a sufficiently low shaft angle, is carried out directly through a shaft log across the lower edge of the transom of the boat. This means that when the craft is at speed only the lower blades of the propellers would be in the water, and the shaft and the boss of the propeller are altogether out of water, and the inertia of the water, as it passes out from under the stern of the craft, in conjunction with the position of the shafts in relation to the hull, absolutely regulates the dip of the propeller blades, either in rough or smooth water, so long as the stern of the craft remains in contact with the water at all. This regulation of the dip of the blades is responsible for the success of the surface propeller.

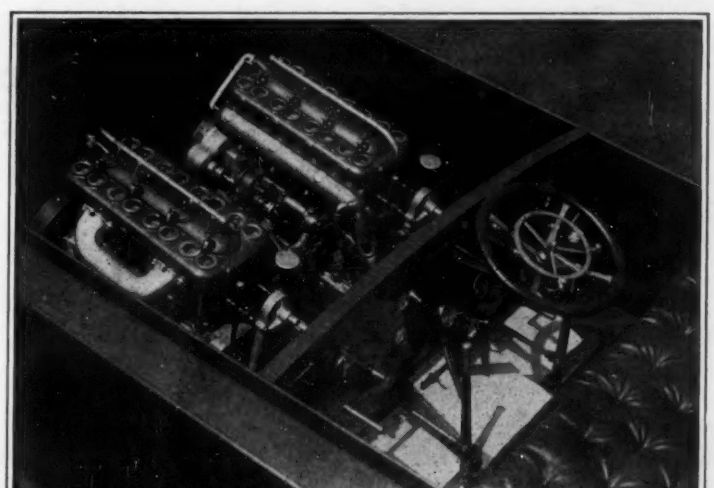
Now let us see how the surface propeller system applies in doing away with the difficulties of the screw propeller in hydroplanes.

Referring to the basic troubles of the ordinary under-water propeller cited above, we find the following advantages for the surface propeller system: There is no under-water shafting, strut bearings, etc., to cause increased resistance, or liable to injury.

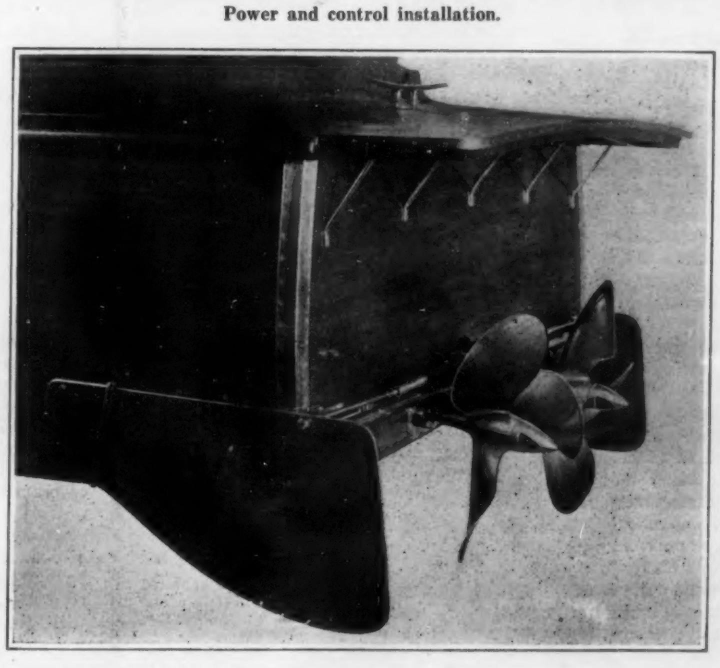
Sea sled built for the United States Navy, running at a speed of 36.45 miles per hour.



View of sea sled, showing inverted V form of hull.



Power and control installation.



Surface propellers and side steering fins are both important features of the sea sled.

The surface propeller craft runs easily through heavy weed growths at high speeds, and there is no tendency to foul the propellers, and the draft of water is one half that of a screw propeller boat of similar size. A 25-foot screw propeller speed boat has, say 30 inches draft at speed. A 25-foot surface propeller boat has less than 15 inches at speed.

Instead of the shafting running in water in non-lubricated bearings, it runs in a strong bearing which is carried in a thwartship timber let into the hull of the boat, carrying a stuffing box which is thoroughly lubricated by a force feed oil pump. Another important point is that the surface propeller is free from any tendency to cavitation, for a reason not at first obvious. When a screw propeller is employed to drive a hydroplane, its area is reduced to the lowest possible limit consistent with planing the boat, so that the engine may be able to handle the propeller at the highest possible number of revolutions after planing has occurred. This means that the propeller is so nearly up to critical pressures that any encroachment of air from the surface, as in broken water, causes total cavitation. The surface propeller, however, may be said to be in a condition of normal cavitation. It depends absolutely on the inertia of the water acting against the face of the blades, and not on the inertia plus a certain water column, plus a certain air pressure. Its wetted area is normally considerably larger than that of the ordinary screw propeller, and the result is that no tendency to cavitation is indicated.

Where one engine is employed one propeller is driven direct by the engine and the other through a gear on the tail shaft line. Where two engines are employed the propellers are driven direct by the engines, through short, stout shafts.

It is to be noted, also, that when two engines are used independently, the throttling of either, in conjunction with the rudder action, furnishes a much more rapid system of steering and control than would be possible under twin screw propellers.

Speaking generally, hydroplane hulls have been of flat, convex, V, or hollow-sided V section, with the keel in all cases below the chine, or angle of the bilge. Even where certain hydroplanes were of hollow section aft, with the chines below the keel, the sections merged into V or convex sections forward. Whatever the modification of bottom may have been the boats were subject to more or less heavy pounding when running at speed in broken water, and even fairly sharp V sections did not obviate this defect. Other points of criticism in regard to the usual type of speed boat are as follows: The ordinary hydroplane works satisfactorily at weights not in excess of 45 pounds to the horse-power, this again being the result of the type of bottom section. Moreover, the accepted type of hydroplane still retains one of the characteristic features of the displacement boat, the vertical stem; and consequently not only incurving topsides forward, but incurving waterlines as well. This meant that if the wedge of the bow was forcibly submerged at speed, as when the stern is lifted on a following sea, the boat must tend to slide or to plane on whichever side the greatest mass of water lay. That is, if the boat were inclined to starboard, she must plane on the surfaces of the starboard bow which were incurving toward the port side; or, more briefly, if she listed to starboard, she must plane to port, her momentum tending to turn her over. This action, known as tripping, was one of the

main dangers and defects of the hydroplane in practical service, and meant not only danger of capsizing but loss of control in rough water.

Another objection was that the incurving topsides forward resulted in the bluff of the bow raising water which would be thrown inboard, especially at moderate speeds.

The object of the new hull was to do away with these defects, and in the attempt virtually every feature of the hydroplane boat as generally understood was reversed. Thus the new craft are of inverted V section, with the keel higher than the chines, or angles of the bilge, at all points, instead of the bottoms being of convex or V sections, the deepest inverted V being near the bow with the depth decreasing toward the stern. By this construction, instead of spray being thrown out it is gathered in under the bottom, and the craft rides on a cushion of mixed water and air, each wave acting as an air compressor, forcing more air under the bottom. This feature has done away with pounding more effectively than anything that has been attempted. This inverted V construction has also resulted in a much greater planing weight than was practical with the older forms of hydroplane, these boats running well with weights in excess of 70 pounds to the horse-power.

The vertical stem is replaced by a horizontal stem, the topsides forward, instead of being incurving, are left parallel, the craft being wider at the bow than at the stern, and the water-lines forward are outcurving instead of incurving. This means that if the craft is turned to starboard, instead of tending to plane to port, she planes to starboard, and so rights herself. It means also that the control is absolute when running in any direction in relation to the sea; so yawing, tripping, and bad control are eliminated. Moreover, the topsides, being parallel, have no tendency to raise water above the deck line, and, as all spray is carried under the craft, instead of out at the sides to be blown inboard, the two chief elements of wetness are done away with.

In this novel craft not even the steering system is left to recall other motor craft. Steering fins, also the invention of Mr. Hickman, are used. These are hinged to the sides of the craft and are operated by a push rod traveling athwartship on the transom, operated by a rack and pinion. The pinion is on the end of the shaft which enters the hull through a stuffing box and is connected by bevel gears with steering wheel column. The fin hinges are not vertical, but are at an angle of about 30 degrees, varying with the power installed, and in action the fins undercut and so pull down the inward side of the craft on the turn, bringing the outcurving water-lines of that side into action. This results in greater rapidity of steering and in freedom from skidding. In fact, small craft of the type may be steered accurately by inclining without the use of the fins. In the twin engine craft varying speeds of the propellers adds a still further element to the rapidity of control.

The sea sled is of a truss type. The engines are right-hand and left-hand, having four cylinders, 4½-inch bore by 6-inch stroke, rated at 75 horse-power, but delivering 80 horse-power at 1,500 revolutions. The engines are placed between bulkheads amidships and are entirely inclosed. Fully equipped with four or five passengers aboard, a weight of approximately two tons, a speed of 35 miles has been attained, and with one passenger an accurate speed test of one of these craft recently showed a speed of 34 knots, or 39.15 statute miles per hour.

The crafts have already been put to tests which would be considered impossible for the older types of speed boat. A 20-foot sea sled went around Cape Cod from Boston to New York and a 26-foot sled ran from Boston to Bar Harbor, much of the time in a stiff easterly breeze, at an average speed of 28 miles for the trip.

Summing up the facts given, it is apparent that the sea sled is a complete reversal of formerly accepted speed boat principles, and the combination of features in the new crafts appears to be entirely novel, for which applications for patents have been made covering the points involved. In the meantime the sea sled has unquestionably proved itself to be a fine all-round water vehicle for speed purposes.

When the clutch is thrown in, the easily revolving surface propellers hardly slow the engine a revolution, and there is no tendency to stall on low throttle. With the throttles opened wide a considerable mound of water is thrown out aft, and the craft begins to lift and ride on the surface of the water at a speed of from 15 to 17 miles an hour. The sensation when riding in one of the crafts is delightful and differs from that of the ordinary speed boat, as the craft is evidently riding on an air cushion which practically eliminates all shocks when running over choppy water. At higher speeds no tendency to instability is felt, the craft automatically maintaining herself on a practically even keel even when running in the trough of a heavy chop. Even in the roughest water the craft is much dryer than other types, and to take solid water over the deck seems to be an impossibility.

Important Communications from the Commissioner of Patents

THE laws of the United States expressly state that patents shall be granted only to first inventors. Hence it is necessary to file with the drawings and patent specifications in which their invention is disclosed, a petition and an oath signed by the inventor himself with due formalities. But what shall be done when, as at present, a foreign inventor finds it difficult, if not impossible, to comply with the statutory requirements? What shall be done, moreover, when the period fixed by the International Convention for the filing of patent applications is so rapidly nearing its close that it is hopeless to secure the signature of an inventor whose instructions were sent to his attorney shortly before war was declared?

The situation arose in two applications which Messrs. Munn & Co. had to file on behalf of foreign inventors whose rights were thus jeopardized through no fault of their own. It was decided to file an application with a petition signed by Messrs. Munn & Co. as attorneys and an oath sworn to by a member of the firm. Our inventor readers in foreign countries will learn with satisfaction that the Commissioner of Patents, in view of the extraordinary circumstances, accepted the papers thus filed.

In order to give the widest possible publicity to the Patent Office's policy, and in order to relieve any apprehension that may exist among foreigners, the Commissioner of Patents has requested us to publish his letter accepting the two applications from Messrs. Munn & Co. The letter follows:

DEPARTMENT OF THE INTERIOR.
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., September 15, 1914.

MESSRS. MUNN & CO.,
Washington, D. C.

Gentlemen: I am accepting two applications filed by you as attorneys to-day, wherein the inventor's name to the petition and specification is signed by you as attorneys and the oath is made by a member of your firm. The time for filing these applications expires under the Convention to-morrow. Therefore, in filing these applications in the form in which you have presented them, you are doing all that you can to save your client's rights, and in permitting them to be filed and giving them a serial number and date of filing of to-day I am doing all I can with the same end in view. If this should not prove to be effective, the loss must be attributed to the troubled conditions of Europe and not laid at your door or that of the Office.

It will be necessary before patents are granted that applications be filed executed by the inventor himself, as provided in Section 4888. Whether the applications to be filed can be tied to the applications which you are filing to-day under the provisions of Section 4887 is, of course, a matter which only a court of last resort can determine. *Ex-parte* Tropenas (90 O. G., 749) to the contrary notwithstanding, I think it a possible construction of Section 4887 that its requirements may be satisfied by the filing of applications executed by an attorney.

I hope, however, in case there are a number of applications executed by attorneys, that Congress may be induced to validate patents granted or to be granted upon proceedings indicated above.

Respectfully,
(Signed) THOMAS EWING, Commissioner.

Indorsements of Patent Attorneys by Congressmen

IT has been the practice in a certain class among patent attorneys to state in their advertisements that they are heartily endorsed by well-known members of Congress. There can be no question that both senators and representatives have given such letters to attorneys, some of whom indulge in practices that can hardly be sanctioned under that unwritten code which governs the foremost members of the patent profession. There can also be no question that the congressmen who have been asked for these indorsements did not realize at the time how their letters would be utilized. The practice has grown to such proportions that the Commissioner of Patents has called the attention of congressmen to the effect of their too willing compliance with requests for endorsement in leading many unsuspecting inventors to place their business with attorneys who, to say the least, are no more qualified than others on the roster of patent attorneys to handle patent matters expeditiously and efficiently. Furthermore, the impression is created that the congressman uses his influence to secure quick and favorable action from the Patent Office.

At the request of the Commissioner of Patents we publish the following correspondence which has passed between him and a member of the Senate. We have refrained for reasons that are obvious to our readers from publishing the names of the attorneys named in the correspondence that follows:

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., July 27, 1914.

HON. MILES POINDEXTER,
United States Senate,
Washington, D. C.

Dear Senator Poindexter: An advertisement appeared in the Seattle *Sunday Times* of May 31st, 1914 (since discontinued), by and Son, reading as follows: "Patents, Trade-Marks, book Free. Strong letter from Senator Poindexter, and Son, Patent Lawyers, est. 1877— Street, N.W., Washington, D. C." On June 4th, Mr. , a lawyer making a specialty of patents with an office in the New York Building, Seattle, Washington, wrote to me that he had within a week heard two inventors express their belief that if they secure the services of and Son in the matter of prosecuting applications, then and Son can have Senator Poindexter personally influence the Patent Office and thereby get quick and favorable action.

In response to this letter I wrote to Mr. , saying that if he would give me the names of the two inventors I would call your attention to it. Not receiving any reply, I wrote to him again on July 17th, briefly, inclosing a copy of my former letter. I am in receipt from him of a letter to me saying that the names of the inventors are Wallace Wilson, 1716 Boylston Avenue, Seattle, Washington, and Frank Warren, 1815 Fifteenth Avenue, Seattle, Washington.

I am of course fully aware that you had no intention of giving any such impression as these inventors drew from the statement of and Son, and there is nothing to show that and Son had any such intention, but this correspondence is a specific showing of the fact that inventors draw a conclusion from letters of Senators and Representatives, which makes it, in my opinion and in the opinion of the Office, highly undesirable that Senators and Representatives give such letters to solicitors of patents.

I submit this for your friendly consideration and will send you copies of the entire correspondence if you so desire.

Sincerely yours,
(Signed) THOMAS EWING, Commissioner.

UNITED STATES SENATE.
COMMITTEE ON EXPENDITURES IN THE WAR DEPARTMENT.
PERSONAL. AUGUST 15, 1914.

HON. THOMAS EWING,
U. S. Commissioner of Patents,
Washington, D. C.

My dear Mr. Ewing: Your letter of the 27th ultimo which reached my office while I was away is at hand, and I am very much obliged to you for calling my attention to the circumstances stated therein. It is extremely exasperating, and I agree with you entirely that it illustrates the advisability of writing no letters of commendation to solicitors of patents, and I believe the same thing applies to any other person engaged in business or having anything to sell. I receive a great many requests for some expression of opinion in regard to books, and the letter I gave Mr. was six lines, acknowledging the receipt of a compilation of patent laws which he had prepared. I have known him for some time and found it difficult to refuse his request for a brief expression of opinion.

I will be very much obliged if you will send me copies of the entire correspondence you refer to, as I want to take the matter up with the inventors who are alleged to have made the statements mentioned.

Thanking you again for calling the matter to my attention, I remain, with very kind regards,

Very truly yours,
(Signed) MILES POINDEXTER.

UNITED STATES SENATE.
COMMITTEE ON EXPENDITURES IN THE WAR DEPARTMENT.

HON. THOMAS EWING, AUGUST 21, 1914.
Commissioner of Patents,
Washington, D. C.

Dear Mr. Ewing: I have yours of 20th instant and if it will be of any service to the administration of your Office to publish the correspondence referred to, I have no objection.

Very truly yours,
MILES POINDEXTER.

The Current Supplement

IN the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2021, there is a story of the Cyclopean Mystery at Abydos, telling of some wonderful ruins recently discovered in Egypt that date back to the earliest periods known to man; and the illustrations give an idea of the huge masonry of the structure which includes the long sought tomb of Osiris and Strabo's well. One of the great engineering works that are being carried out by the different railway companies for the improvement of traffic is described in the article on the Magnolia Cut-off, on the Baltimore & Ohio Railroad, and the numerous illustrations tell a story of their own on how a railroad is built. There is another instalment on the great address by Prof. Bateson on Heredity in this issue, as well as an interesting paper on plant autographs, showing how plants are compelled to make a written record of their life story. A paper by Orville Wright, who is probably the best known expert in the world on the subject, tells of the intricate questions connected with the stability of aeroplanes, and his explanation, given in considerable detail, without any figures or mathematics, is one of the clearest and most easily understood discussions that has yet appeared. Problems involved in the cracking of oils are treated in a carefully written article that will interest automobile engineers.

The Work a Watch Does.—Out of sight, out of mind, is particularly true in regard to the mechanism of a watch, and even those interested in mechanical matters seldom consider the amount of work performed by this useful little piece of machinery. Take the balance wheel, for example. In the average watch this vibrates 300 times a minute, 18,000 times each hour, 432,000 times a day and 157,788,000 times a year. As each vibration covers about one and a half revolutions, the shaft on which the balance wheel is mounted makes 236,682,000 revolutions in its bearings each year. Compare this with a modern locomotive with 7-foot drivers, which would have to run 985,824 miles to make an equal number of revolutions; and, running at the rate of a mile a minute, without stopping, it would take 683 days, or nearly two years for the axle of the drive wheel of the locomotive to make as many revolutions as the balance wheel shaft of the watch does in one year, and it would cover a distance of over 39 times around the world.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Origin of Life

To the Editor of the SCIENTIFIC AMERICAN:

Your article in issue of August 1st on "Another View of the Origin of Life," referring to the action of chlorophyl in transforming the energy of sunlight into chemical energy, closes with the words, "Thus life has originated, and probably still originates, by the law of molecular complexity."

Dr. William Hanna Thomson in his "What is Physical Life? Its Origin and Nature," makes short work of all these materialistic, physico-chemical theories of the origin of life, supporting his argument with quotations from leading authorities.

I believe there is not one single biologist of any note who would entertain for a moment the physico-chemical theory. In fact, the laws which govern physics and chemistry are totally and essentially different from those of life.

May I refer those interested in this subject to Bergson's "Creative Evolution," where they will find much of deep interest? He shows that the human intellect has arisen, or evolved, from the animal world especially to deal with matter, fabricating it into instruments for its use; the consequence is the brain "thinks matter," and is led to regard the world as a machine.

This is the reason why so many superficial thinkers incline to materialism, especially physicists. Intellect and instinct have both evolved from consciousness, but taken different paths—the former to deal with material surroundings, the latter with life.

"The intellect is characterized by a natural inability to comprehend life."

But "an intelligent being bears within himself the means to transcend his own nature."

Bergson also gives many examples showing that the mechanical theory of the universe is quite untenable; and Sir George Darwin in his presidential address to the British Association in 1905 said that the mystery of life is as impenetrable as ever. A. K. VENNING.

Los Angeles, Cal.

The Power Required to Stop an Automobile

To the Editor of the SCIENTIFIC AMERICAN:

In answer to X. Y. Z. concerning the power necessary to stop an automobile of given weight and in a given distance (July 4th issue), I submit the inclosed solution, which I believe to be correct. The answer, however, strictly speaking, is in force or work units, rather than in power, as the time required to stop the machine was not given.

SOLUTION.

Weight = 3,500 pounds.
Initial velocity = 20 miles per hour.
Final velocity = 0 mile per hour.
Distance = 30 feet.
Using following notation:

t = time,	av = average velocity,
s = distance,	v = final velocity,
a = acceleration,	u = initial velocity,
F = force in pounds,	ch = change in velocity,
W = weight in pounds,	g = constant = 32*,

20 mi./hr. = 105,600 ft./hr.

$$av = \frac{u+v}{2}$$

$$av = \frac{105{,}600 + 0}{2} = 52{,}800 \text{ ft./hr.}$$

$$t = \frac{s}{av}$$

$$t = \frac{30}{52{,}800} = .000568 \text{ hour} = 2.05 \text{ seconds}$$

$$ch = u - v,$$
$$ch = 105{,}600 - 0 = 105{,}600,$$
$$105{,}600 \text{ f ./hr.} = 29.33 \text{ ft./sec,}$$

$$a = \frac{ch}{t}$$

$$a = \frac{29.33}{2.05} = 14{,}309 \text{ ft./sec.}^2$$

$$F = \frac{W}{g} \times a$$

$$F = \frac{3.500}{32} \times 14.31$$

F = 1,565.09 pounds force required to stop automobile.

The pound is used in F as a force unit and in W as a weight unit; thus by using the constant g in the equation $F = \frac{W}{g} \times a$, W is changed to units equivalent to those of F.

To change answer to work:
$F \times S$ = work.
1,565.09 × 30 = 46,952.7 ft. lbs., work done.

Freeport, L. I. EDWARD T. COLLINS.

* The value of g is 32 only when the *pound* is used as a force unit.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the automobile problem that appeared in the July 4th, 1914, issue of the SCIENTIFIC AMERICAN, may I submit the following analysis, which to me seems to be by far the simplest and clearest of any of the half dozen I have worked through?

First: Since the results are not affected by the character of the retardation, we will assume uniform retardation.

Then, if F = force,
M = mass,
W = weight,
A = acceleration,
G = acceleration due to gravity,

$$F = Ma = \left(\frac{W}{g}\right)a \qquad (1)$$

A fundamental mechanical expression, also from the familiar expression:

$$V^2 = 2AS \qquad (2)$$

in which V = velocity at any instant,
A = acceleration,
S = space passed over.

We get:

$$a = \frac{v^2}{2s} \qquad (3)$$

Substituting 3 in 1, we get:

$$F = \left(\frac{W}{g}\right)\frac{v^2}{2s} \qquad (4)$$

In the problem proposed:
W = 3,500 lb.,
G = 32.16 ft./sec./sec. (usual vlaue),
S = 30 ft.,

$$V = \left(\frac{88}{3}\right)\text{ft./sec.}$$

Arrived at from the easily remembered fact that

$$60 \text{ mi./hr.} = 88 \text{ ft./sec.}$$

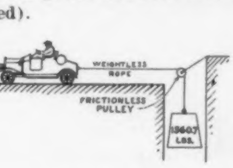
$$\text{Hence } 20 \text{ mi./hr.} = 88\left(\frac{20}{60}\right)\text{mi./hr.}$$

Substituting these values, 4 becomes:

$$F = \left(\frac{3500}{32.16}\right)\frac{\left(\frac{88}{3}\right)^2}{2(30)} =$$

$$\left(\frac{3500}{\frac{32.16}{2.01}}\right)\frac{\frac{22}{88}\left(\frac{11}{88}\right)}{9(2)30} = \frac{84700}{54.27} = 1560.7 \text{ pounds.}$$

Hence, if an automobile weighing 3,500 pounds were traveling at a uniform rate of 20 miles per hour and a backward pull of 1,560.7 pounds were being constantly and uniformly exerted on it, the car would come to rest in just 30 feet after power had been shut off (e. g., the clutch disengaged).



To find the horse-power thus absorbed (which would be the same as the horse-power required to accelerate a 3,500-pound car from a standing start to 20 miles within a distance of 30 feet) is now a simple matter.

$$\text{H. P.} = \frac{\text{ft. lb./sec.}}{550} \qquad (5)$$

Hence we must calculate the time required to bring the car to a stop under the conditions of the problem.

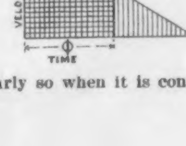
This is easiest shown graphically: Since in uniform motion

$$S = VT \qquad (6)$$

in uniformly accelerated motion

$$S = \frac{(v_i + v_f)}{2}t \qquad (7)$$

in which S = space passed over,
v_i = initial velocity (ft./sec.),
v_f = final velocity (ft./sec.),
t = time (seconds).



Seven is clearly so when it is considered that, referring to 6 and the diagram, obviously space is the product of (velocity) (time during which that velocity exists) which, in the diagram, means that space passed over = shaded area.

Thus, if ϕ units of time elapse, the area involved is expressed by 7.

When $v_f = 0$ (as in our case) 7 becomes

$$S = \left(\frac{v_i + 0}{2}\right)t = \frac{v_i t}{2} \qquad (8)$$

which may be expressed

$$t = \frac{2S}{v_i} \qquad (9)$$

which in our case is:

$$t = \frac{2S}{v_i} = \frac{2(30)}{\left(\frac{88}{3}\right)} = 2\left(\frac{15}{30}\right)\left(\frac{3}{\frac{88}{22}}\right) = \frac{45}{22} = 2\tfrac{1}{22} \text{ sec.}$$

Substituting in 5,

ft. = 30
lbs. = 1560
$$\text{sec.} = t = \left(\frac{45}{22}\right)$$

$$\text{H.P.} = \frac{\text{ft. lbs./sec.}}{550} = \frac{30(1560)}{550\left[\frac{45}{22}\right]} = \frac{624}{15} = 41.6 \text{ H. P.}$$

Q. E. F.

Pilot Knob, N. Y. E. P. CULVER.

Technical Literature by Untechnical Men

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of July 11th, one Mr. Rindsfoos takes issue with a writer in a "high-class conservative monthly," who had had the temerity to write an article called "Skyscraper" without being able to append C.E. to his name.

I would suggest that Mr. Rindsfoos absorb that story of Tennyson and Adam Babbage.

The former wrote a poem called "The Vision of Sin," with lines which ran—

"Every moment dies a man,
Every moment one is born."

Babbage wrote to the poet:

"In your otherwise beautiful poem there is a verse which reads:

"'Every moment dies a man,
Every moment one is born.'

"It must be manifest that were this true, the population of the world would be at a standstill. In truth, the rate of birth is slightly in excess of that of death.

"I would suggest that in the next issue of your poem you have it read:

"'Every moment dies a man,
Every moment 1-1/16 is born.'

"Strictly speaking, that is not correct. The actual figure is a decimal so long I cannot get it in the line, but I believe 1/16 will be sufficiently accurate for poetry. I am, etc."

Mr. Rindsfoos may be a good engineer, but he ought not to measure literature with a micrometer.

Chicago, Ill. HOWARD V. O'BRIEN.

Who Ever Spent $5,000 for a Butterfly?

To the Editor of the SCIENTIFIC AMERICAN:

In an article on "Making Money Out of Butterflies," that appeared in the SCIENTIFIC AMERICAN for June 20th, Mr. Moulton says that some butterfly farmers of Europe have reared specimens selling for $5,000. Will not Mr. Moulton kindly tell your readers who these dealers are, and, above all, what the specimens are that are worth $5,000? It is barely possible that, like the statement "many mosquitoes weigh a pound," Mr. Moulton was treating of the sale of butterflies in the aggregate, but it sounds as if he meant—and he probably did mean—$5,000 each.

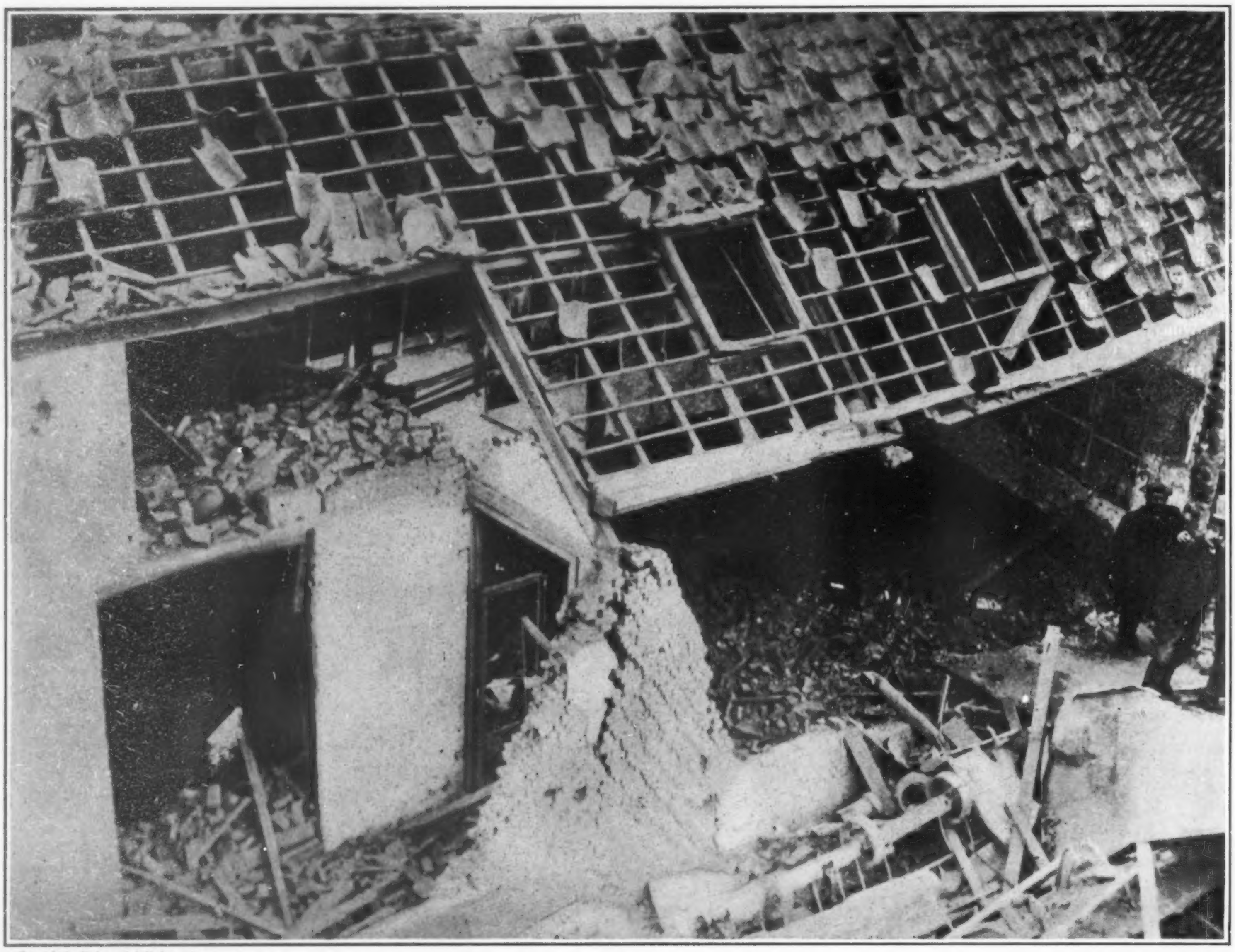
During my forty years' experience in both buying and selling natural history material, I have never even heard of a butterfly having sold for such an enormous price, nor, in fact, anything like that sum, and the statement is likely to arouse in some of your readers expectations destined never to be realized.

Many years ago, when at the United States National Museum, the correspondence clerk was kept busy contradicting the statement that a certain butterfly had recently been purchased for the sum of $20,000. Quite recently a statement, equally false, went the rounds of the papers, stating that Sir Walter Rothschild had paid $1,000 for a flea.

As a matter of fact, there is hardly a natural history specimen of any kind, save precious stones, that cannot be purchased for $5,000, and usually a great deal less. F. A. LUCAS,

Director of the American Museum of Natural History.

New York city.



The bombs which caused the damage here shown were intended for the wireless station, but fell wide of their mark. Although roofs were blown off and whole houses destroyed, no one was killed in this second attempt to bombard Antwerp from the air.

The Effect of the Zeppelin Bombardment of Antwerp

Remarkably Destructive Result of Shrapnel Bombs Dropped from the Sky

WHEN one views the photographs on these pages, photographs which show structures of Antwerp all but demolished by bombs hurled from Zeppelin dirigible airships, it seems incredible that thousands in the densely populated city were not killed outright. The bombs were filled with bullets and therefore resembled shrapnel shell, which is considered the best type of artillery ammunition for general use. Artillery shrapnel shells contain only a small bursting charge, for the velocity of the shells acquired by their propulsion from a field gun (about 2,000 feet per second at the muzzle) is sufficient to impart enough destructive energy to the bullets themselves, and to propel them after the shell has burst. Since the Zeppelin dropped its shrapnel bombs from a height that could not have been less than 3,000 nor more than 5,000 feet, it is not unlikely that more than a bursting charge was used. Our pictures certainly testify to a scattering effect which transcends anything that may be expected from ordinary shrapnel.

Terrible as the destruction was to property, the loss in human life was comparatively small. On the first attempt eight bombs were thrown down and twelve people killed. On the second attempt no one was killed, but several people were injured. In a densely populated city this can hardly be called slaughter.

No technical accounts have reached this side of the Zeppelins' exploits, but according to William G. Shepherd, a United Press staff correspondent who writes in the New York *Sun*, an attempt was made to fight off the Zeppelin which sailed over Antwerp on September 2nd. He assures us that 30,000 soldiers were in the streets of Antwerp at the time and that all of them were shooting with their rifles directly at the Zeppelins which menaced their city. Whether this rifle fire drove off the Zeppelin or whether it had exhausted its supply of explosives does not appear, but the ship slowly drew away. It seems that the wireless telegraph station was the object of this second attack, although two of the eight bombs which were dropped fell within thirty yards of the Red Cross hospitals. On this second attempt, two children, three women, and five men were injured, though not seriously, chiefly because all the terrified families of the city had taken refuge in cellars; the week before, the same Zeppelin had killed twelve people.

The British Dreadnought "Iron Duke"

THE spirited drawing on the cover of the present issue represents the "Iron Duke," flagship of Sir John Jellicoe, the commander-in-chief of the British fleet in the North Sea. The ship is shown stripped for action, with stanchions, rails, boats, etc., and everything that would interfere with the fire of the ship's batteries removed.

In this condition practically the whole of the ship's complement are behind armor and out of sight. Only upon the signal bridge and on the fire-control platform upon the mast are there any officers and men in the open.

If the engagement is taking place at the normal fighting range of, say, 9,000 to 10,000 yards, only the main battery of ten 13.5-inch guns mounted in the five turrets will be manned; the gun crews of the torpedo defense batteries, which are protected by armor too light to keep out the 11- or 12-inch shells of the German ships, will be below, behind the shelter of the heavy 10- and 12-inch belt and side armor. But each gun crew will be within easy reach of its own 6-inch gun, should the ship be threatened with attack by the enemy's destroyers. Such an attack would be unlikely except in the later phases of a line-of-battle engagement, when the battleships on one or both sides have been so badly punished that the main batteries are more or less silenced and the speed and maneuvering power of the ships has been impaired. It would be in this phase of the fight, probably, that the destroyer flotillas would attack, and then the defense of the ship would fall to the battery of 6-inch rapid-fire guns—or such of them as had not been disabled by the attack at long range with the main batteries of 11- and 12-inch guns.

The "Iron Duke" and her sister ships, "Marlborough," "Benbow," and "Emperor of India," are the last of the British ships to mount the 13.5-inch guns. The next following ten ships, viz., five of the "Queen Elizabeth" class and five of this year's programme, will each carry eight of the new 15-inch guns, which, as compared with the 13.5-inch gun of the "Iron Duke" class, show an increase of 30 per cent in energy and of 50 per cent in the destructive effects produced within the ship whose armor may be penetrated.

The "Iron Duke," as will be seen from the accompanying line engraving, mounts ten 13.5-inch guns in five turrets, all of which are mounted on the center-line of the ship. Two turrets are carried on the forecastle deck, one amidships on the main deck, and two aft on the quarter deck. These guns are protected by 12 inches of armor on the turrets and barbettes.

The torpedo defense battery of twelve 6-inch guns is mounted on the main and gun decks. Ten of these are carried in a battery forward of the mast, which is protected by 8 inches of armor, and eight of them can be trained dead ahead and two dead astern. The other two 12's are mounted aft on the gun deck.

The concentration of fire is four 13.5-inch and eight 6-inch ahead, four 13.5-inch and four 6-inch astern, and ten 13.5-inch and six 6-inch on each beam. The "Iron Duke" also has four torpedo tubes for launching the 21-inch torpedo.

The armor protection of the hull is very complete, consisting of a main water-line belt 12 inches amidships and 6 inches at the ends, which extends 6 feet below the water-line and 10 feet above it, to the level of the gun deck. Above this, extending between No. 1 and

Havoc caused to houses just outside the city by the second bomb-throwing raid on Antwerp.

Windows broken in a residence in the Rue de la Justice. Note the holes made by shrapnel bullets.

No. 5 turrets, is an upper belt, 10 inches thick, which reaches to the main deck.

The ship is further protected by several steel decks, and, as a safeguard against aerial bombs, special steel armor is provided above the magazines. Several 3-inch, high-angle guns are carried as defense against aerial attack.

The "Iron Duke" is 580 feet long, 90 feet broad, and its normal draft is 28 feet, at which draft her displacement is 25,000 tons. The ship is driven by Parsons turbines, and with a shaft horse-power of 31,000, a speed of 22 knots is secured. The normal supply of coal is 1,000 tons and the maximum bunker capacity is 2,700 tons. Also 1,000 tons of oil are carried in the double bottom.

The flotation of the ship is assured, even in the case of severe mine or torpedo damage, by twenty-one transverse bulkheads, and by four longitudinal bulkheads, evenly spaced, which extend throughout the full length of the ship. This is supplemented by several watertight steel decks and flats, and by special, longitudinal, armored bulkheads to limit the explosive effects of the torpedo.

Aluminium Vessels

NOW that aluminium utensils are coming into use, it will be interesting to note the following experiments made by Prof. John Glaister of the Glasgow University, his object being to find whether various aliments were likely to attack the metal. He finds that the only substances that attack the surface are oranges, lemons, Brussels sprouts, and tomatoes, but even in this case the quantity of aluminium dissolved is insignificant and quite inoffensive. It is already known that aluminium is not affected by air at any temperature and it does not blacken on contact with hydrogen sulphide as silver does. As the metal is easily cleaned, it appears that such utensils have all the advantages, and all kinds of foods can be prepared in them without danger. Another advantage that they share with copper vessels is that, being of thin metal, they heat up very quickly. For electric or flame heaters, this means quite an economy of heat, as less heat is now lost in warming up the material of the vessel. This refers specially to rapid heating, such as boiling of water and the like.

A view of the houses just outside the city of Antwerp which were wrecked in the second bomb-throwing raid of the German Zeppelin.

The Heavens in October

Ninth Satellite of Jupiter Discovered; Visibility of Delavan's Comet

By Henry Norris Russell, Ph.D.

AN announcement of much interest comes in a recent telegram from Prof. Tucker, who is at present acting director of the Lick Observatory, Prof. Campbell being detained abroad after observing the total solar eclipse of last August. On July 21st, Mr. Nicholson, at that observatory, photographed a faint object in the vicinity of Jupiter, near the eighth satellite, but still fainter. Further observations have been secured, and the telegram states that the calculation of the orbit of the newly discovered body proves it to be a satellite of the great planet—the ninth to be discovered. No further details are at hand at the moment of writing. It appears, however, that the new satellite must be remote from the planet, probably several millions of miles at the least, with a correspondingly long period. It will be very interesting to see whether it is moving around Jupiter in the same direction as the motion of the planets around the Sun (like the sixth and seventh satellites), or in the opposite direction, like the eighth.

This tiny body, however, is so faint that it must be near the limit of visibility, if not beyond it, in the greatest telescopes, and it can only be observed photographically. The amateur observer can find more to interest him in Delavan's comet, which is now a conspicuous object, and will be so throughout October. At the present time it is so far north that it just grazes the northern horizon at about 10:30 P. M., and is visible both in the evening, low down and a little west of north, and in the morning, higher up and in the northeast. It appears to the eye fully as bright as a third magnitude star, and has a tail several degrees in length. Prof. Barnard, at the recent meeting of the American Astronomical Society, called attention to the fact that, in the case of this comet, as much could be seen of the tail with the naked eye as could be photographed. For most comets the tail is far brighter photographically than visually. In the present case there must be a much smaller proportion of violet and ultra-violet light in the radiation of the tail than ordinarily.

On October 1st the comet will be in approximately 12 hours 30 minutes right ascension and 44 degrees north declination, and can be found by drawing a line from α to γ Ursæ Majoris (diagonally across the bowl of the Great Dipper) and carrying it southward for about its own length. On the 5th it passes about 2 degrees north of the bright star α Canum Venaticorum. It continues to move east and south into Boötes, and on the 27th it will be about 6 degrees north of Arcturus. It is so bright now that a mere glance along this line will reveal it, if only the sky is clear, and the moon out of sight. All through the month the comet is in almost the same right ascension as the Sun, so that it is visible in the northwest just after dark and the northeast before dawn. It is so far from the Sun in the heavens—44 degrees north of him on the 1st and 38 degrees on the 31st—that it will be well above the horizon after twilight has faded and before it begins.

Though it appears fairly near the Sun in the heavens, it is actually far behind it. Its nearest approach to us, about October 5th, leaves it fully 145 million miles distant, and by the end of October it is 160 million miles from us. Its tail, too (which is directed away from the Sun) points away from us, so that we see it very much fore-shortened, which accounts for its apparent shortness and relatively wide angle of divergence.

Though less conspicuous to the eye than some other recent comets, notably Halley's, this is really a bigger affair. Had it come as near to the Sun and to us as Halley's comet did, it would have appeared fully one hundred times as bright as it does now and rivaled Jupiter in splendor.

Even in its present remote orbit, it will remain easily visible to the naked eye until the middle or end of November, and will be observable, telescopically, in the morning sky, south of the equator, for many months more, probably until the summer or autumn of 1915.

The Heavens.

We return this month to our usual custom of presenting a map which exhibits the sky as it appears in the latter part of the evening or in the early evening of the following month. A good starting-point in identifying the constellations will be found in the Great Square of Pegasus, whose corners are marked by four stars of the second magnitude, about 15 degrees apart. At the hours listed at the bottom of this map, this will be just south of the zenith and very high in the sky. Earlier in the evening it will be in the southeast and not quite so high up.

From the northeastern corner of this square, marked by a star which really belongs to Andromeda, runs a conspicuous line of bright stars, spaced at distances about equal to a side of the square. The first of these, Beta Andromedæ, serves as a guide-post to a very interesting object, the Great Nebula in Andromeda. As the map shows, there are two small stars above it, in a line almost at right angles to the main line of bright stars already spoken of. Just above the second of these is the nebula—a hazy patch of light, easily visible to the eye, and more conspicuous in a field-glass. Only photography reveals the great spiral extensions which make this one of the most magnificent objects in the heavens, but even without these it is an impressive object. The impression grows, when we consider that its distance is at least as great as that of the nearer stars, and probably very much greater, so that its diameter is probably at least 1,000 times that of the whole solar system, if not greater. Still more amazing is the recent discovery of Dr. Slipher of the Lowell Observatory, who finds, spectroscopically, that the nebula is approaching us at the enormous rate of nearly 200 miles per second—a result now confirmed by other observers. The nebula is apparently almost fixed in the heavens, having little or no proper motion; and, if its velocity at right angles to the line of sight is at all comparable to that of its approach, its distance must be many hundreds of light-years, perhaps thousands, and it must be many light-years in diameter. Its spectrum closely resembles that of the Sun; but how such a gigantic thing can give off light of this sort is not quite clear. It may be a great star-cluster, enormously distant, or one high central star, surrounded by a fog of some sort which reflects its light. We do not know yet, but more light may be thrown on the subject by the observations of the next few years.

Returning to the line of stars with which we started, we pass by the bright red star Gamma Andromedæ into Perseus, which lies in the Milky Way. Below this we find Auriga, with the brilliant yellow star Capella, and above it the zig-zag line of Cassiopeia. The bright patch in the Milky Way between Perseus and Cassiopeia is a magnificent star-cluster, seen well with even a small telescope.

Due east, to the right of Perseus and Auriga, is Taurus, distinguishable at once by the small but prominent group of the Pleiades and the V-shaped one of the Hyades, lower down. Beneath this Orion is rising, and above and to the right is the flattened triangle which marks the head of Aries. The great dull region in the southeastern sky is shared by the large but not very important constellations Eridanus and Cetus.

The southwestern sky is almost as dull, except for the presence of one bright star, Fomalhaut, in the Southern Fish, and of the far brighter planet Jupiter, which is now in Capricornus.

The three brightest stars in the west are Altair, in Aquila (on the left), Vega, in Lyra (on the right), and Deneb, in Cygnus, above the latter. In the north we find the Great Dipper close to the horizon, right below the Pole, and Ursa Minor and Draco above it and to the left.

The Planets.

Mercury is an evening star all through this month, but is so far south of the Sun that he is very unfavorably placed. He is best observable about the 10th, shortly before his greatest elongation, which occurs on the 15th, but he sets within a few minutes after 6 o'clock, and can be seen only with difficulty.

Venus is evening star in Libra and Scorpio, and is conspicuous in spite of her great southern declination. On the 23rd she passes 1 degree south of Antares, and it will be hard to see even this first-magnitude star so near the brilliant planet, especially as both are very low in the southwest, setting about 6:30 P. M.

Mars is evening star in Virgo and Libra, but is too near the Sun to be well seen. He is in conjunction with Mercury on the 5th and again on the 30th, but both planets will be very low in the twilight.

Jupiter is in Capricornus, coming to the meridian at 8:22 on the 1st and 6:27 on the 31st, and is the chief ornament of the evening skies.

Saturn is in Gemini, rising at 10 P. M. at the beginning of the month and 8 P. M. at its close.

Uranus is in Capricornus, and is almost stationary in the sky during the month, being never more than 3 minutes from a point in 20 hours 41 minutes 16 seconds —18 degrees 59 minutes. He is in quadrature, 90 degrees east of the Sun, on the 31st.

Neptune is in Cancer, and is likewise in quadrature, on the 24th, but is west of the Sun, and observable in the morning.

The Moon is full at 1 A. M. on the 4th, in her last quarter at 5 A. M. on the 12th, new at 2 A. M. on the 19th, and in her first quarter at 6 P. M. on the 25th. She is nearest us on the 19th and farthest off on the 6th. During the month she is in conjunction with Saturn on the 10th, Neptune on the 13th, Mars and Mercury on the 20th, Venus on the 21st, and Uranus and Jupiter on the 26th.

Princeton University Observatory.

At 11 o'clock: Oct. 7.
At 10½ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.

At 9 o'clock: Nov. 7.
At 8½ o'clock: Nov. 16.
At 8 o'clock: Nov. 23.

At 9½ o'clock: October 30.

NIGHT SKY: OCTOBER AND NOVEMBER

Electrical Heating for Buildings

ELECTRICAL heating of rooms, on the hot-water system, is now carried on in Stockholm. In the top story of a building is a heat-insulated water tank of 100 to 300 gallons with electric heating devices for the water. During the night the water is heated up, for the price of current is less at such hours, and in some cases extra low night rates prevail. An automatic device switches off current in the morning and throws on an electric motor pump, and this sets up circulation of warm water in the radiators throughout the building. In the basement is the pump and a small water tank from which the water goes up to the roof tank and keeps up a constant circulation. In the evening the pump is switched off and the current sent to the heater tank, preferably by the use of a hand switch. A heat storage tank of 125 gallons using 4 kilowatts and 10 hours charging at night will take in heat enough to suffice for radiators in 4 or 5 rooms. With a 250-gallon tank and 6 to 8 kilowatts, 8 rooms can be very well heated. It is claimed that the present method is one of the best as well as most economical for use, all things considered, and it is quite automatic in action and does not get out of order.

Open-air cookers for picnickers.

Fire Precautions in a California Park

IN order to reduce the possibility of great damage resulting from forest fires, the city of Los Angeles has adopted the idea of prevention, and has waged an effective campaign along that line.

Through the fine philanthropy of Col. Griffith of Los Angeles, the city recently fell heir to Griffith Park, a natural forest reserve taking in many hundreds of acres of the most beautiful forest trees in southern California.

The big park has long been a picnic ground for pleasure-seekers, and in days gone by the trees have suffered seriously from fires rising out of hot beds of coals carelessly left by pleasure parties when they broke camp. The beautiful trees were also damaged occasionally by the burning of trash and brush in sections of the park where trees stood close together.

One of the first things the Park Commissioners did was to have a blacksmith build a brush incinerator for the park. This incinerator is merely a big sheet iron hopper mounted upon a sheet iron wagon box, which served as the firebox. The incinerator has three small implement wheels, one running in front, at the butt of the tongue, to make short turns possible. The incinerator hopper is hooded by a semi-circular piece of sheet iron which is profusely perforated. This hood is so arranged that it can be swung over and made to shield either side of the incinerator. The theory of the thing is that the park attendants drive the brush burner to points where there is brush or trash to burn, and then the hood is turned as required, to serve as a heat and spark shield. In this way the trees are never scorched or endangered while brush is being burned in the park.

One of the other novelties of the forest fire prevention campaign is the open-air furnace and fireless cooker. Both of these objects are made of cement and cobblestones. The furnace is an open firebox with a stone chimney. The fires are fed with waste wood, and the firebox is covered with a piece of heavy woven wire, upon which vegetables, eggs, pots of porridge, meats, or bread can be boiled, broiled, cooked, or toasted. Similarly, the so-called "fireless cooker," which is merely a round stone barrel, may be filled half full of coals from the furnace, after which it can be filled with vegetables to bake, or a pot of partially cooked food can be set within it to be finished off.

These two cooking novelties find great favor among the picnic parties which visit the big park. It is now unlawful to build camp fires in the park, but the pleasure parties no longer care to build them, for their wants have been supplied by the thoughtful Park Commissioners.

The Los Angeles campaign of park forest fire prevention has worked out satisfactorily. Some of the salient features of it might be advantageously applied in other localities where there are splendid forests to be protected against the danger that frequently arises from visits of careless hunters and pleasure seekers.

A natural bridge in Argentine.

Monument for Capt. Scott

THE committee appointed to select a design for a monument for Capt. Scott and his associates who sacrificed their lives in their endeavors to reach the south pole and explore Antarctic regions, has finally chosen for execution the model submitted by Albert H. Hodge.

A photograph of the model is reproduced herewith. It personifies "Courage," crowned by "Immortality." The reliefs on the sides represent the following subjects: On the north side, "To Strive," showing the difficulties encountered on the journey; on the south, "To Seek," showing the start for the pole; on the east, "To Find," showing the party at the pole; and on the west, "Not to Yield," showing the snow-covered tent, which was the last resting place of the explorers.

Monument for Capt. Scott, the Antarctic explorer.

Gas Batteries

By Harry N. Holmes

GAS cells of many types have been invented, but they all are closely related to the fundamental type. Two tubes with electrodes of platinum sealed in the walls are inverted in a cup of hydrochloric acid, for example. If the tubes are filled with hydrogen and chlorine gases, respectively, and so arranged that the platinum electrodes are partly covered with gas and partly covered with acid solution, we have a simple gas battery. Connect the electrodes by a wire and a current will flow through the circuit. At the same time the gases will go into solution. Of course if built as directed the battery would soon run down, but inlets for a continuous supply of gases could easily be made and a steady current of electricity drawn from the device.

The scientific explanation involves reference to the ionic theory, but is really quite simple. Hydrochloric acid in water solution breaks up into charged particles called ions. The hydrogen ion carries a positive charge and the chlorine ion a negative charge. Now the hydrogen gas which is not charged and not ionized has a tendency to pass into solution, but this it cannot do without becoming ionized. Therefore it takes the needed positive charges from the platinum electrode and goes into solution, leaving the electrode negative. At the other electrode the opposite is happening. Chlorine gas tends to pass into solution, but to do so it must become ionic. The needed negative charges are taken from the platinum pole, leaving it positive. With one pole positive and the other negative, it is evident that an electric current will flow through a connecting wire. A feature to be noted is that the osmotic pressure of the ions already in solution exerts an outward push or opposing force, which finally becomes great enough to stop further solution of the gases unless the liquid is steadily removed and a weaker solution caused to replace it. However, that is a mere mechanical detail.

Other gases such as hydrogen and bromine or hydrogen and iodine or hydrogen and oxygen, and many other combinations, may replace the first named pair, the only requisite being that the two gases will react with each other. Hydrogen and oxygen, for example, will unite in a flame to form water, and this same reaction takes place when they are used in forming a gas cell, though there is no flame, the energy appearing as electricity instead of heat. Any solution that conducts electricity well will serve instead of the hydrochloric acid mentioned in the original illustration. Water gas and air are easily obtained commercially, and will contain the oxygen and hydrogen of one variation.

The Junger cell is somewhat different from the above, and yet it is a gas cell. A bar of iron is placed in the bottom of a glass jar, which is filled with a water solution of some salt such as ammonium chloride or sulphate. Above this is a porous cup filled with a carbon rod surrounded by lumps of graphite. Air to furnish oxygen is pumped into the porous carbon and a current is found to flow in the cell from iron to carbon.

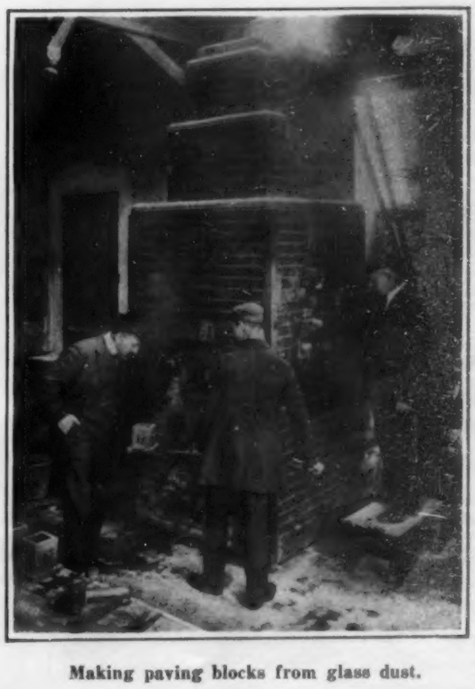
Portable incinerator for burning brush.

A Remarkable Natural Bridge

IN Argentine there is a natural bridge that is one of the most wonderful in the world. It spans the Rio Mendoza and is known as the Inca Bridge. But it is the work of Nature, and not, as was popularly supposed, of the Incas. The road on which it occurs was probably a colonial highway made by the Peruvian Incas, who took advantage of the phenomenon by leading their road over this natural viaduct.

Glass Paving Blocks

A NEW use for the glass dust that collects in glass works has recently been discovered in Berlin. The dust is gathered up and placed in a furnace where it is reduced to molten "lava." The lava is then run into molds the size of a paving block. The glass bricks thus formed are found to be as hard as granite and eminently adapted for paving, giving a smooth and strong street surface. The accompanying photograph shows the filling of a mold. The man at the right is controlling the flow of the glass by operating a valve.



Making paving blocks from glass dust.

The Motor-driven Commercial Vehicle

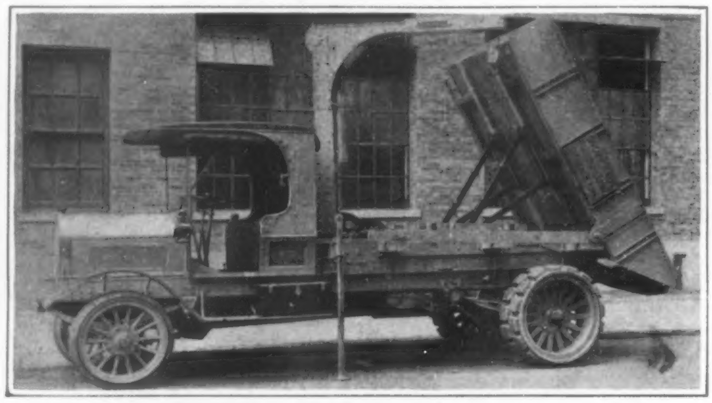
This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

Dumping Truck With Swinging Crane

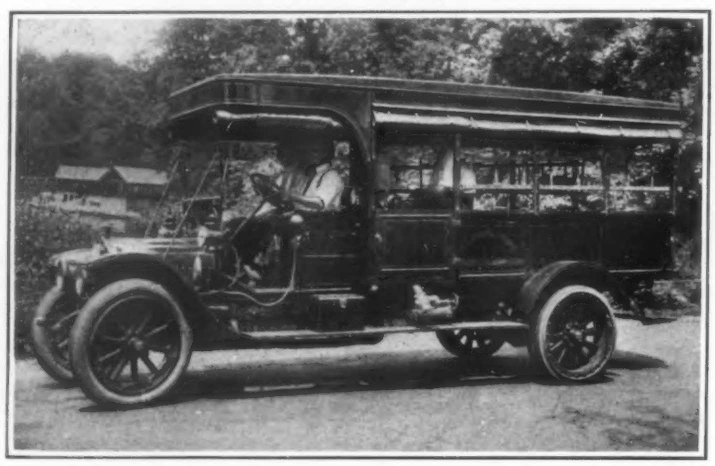
TO clean out the sediment deposited in sewers a tripod derrick is usually set up over a sewer manhole and the sludge is raised with buckets hauled up by a gang of men. As this is a slow and laborious process the Bureau of Sewers of the Borough of the Bronx, New York, has had a special motor truck built with a swinging crane and a large water-tight dumping body. The truck is run along side the sewer manhole and then with the crane, which is operated by power from the truck motor, it is possible to raise and dump into the body a bucketful of silt weighing a ton and a half. The body has a capacity of 3½ cubic yards. In dumping it may be raised to an angle of 60 degrees.

The hoist consists of an upright about 8 feet above the floor of the truck, with an arm extending out, which gives the crane an effective radius of 8 feet. This crane is operated from the clutch shaft and controlled by a lever which is directly behind the cab, within easy reach of the driver. It is possible to rotate the crane by hand so that material can be picked up from either side of the truck. The crane rotates from 200 to 220 degrees. With the propeller shaft revolving at 600, the crane has an effective hoist speed of 20 feet per minute. The truck is equipped with a 50 horse-power motor.

A truck of this type offers many possibilities in the trade. It can be designed with either a platform, rack, or dump body for carrying any commodity that can be picked up with grappling hooks or gathered up in a bucket or scoop. With the power crane it should make easy the handling of such diverse material as cut stone, bales of cotton, castings, etc.



Truck for cleaning sewers, equipped with swinging crane and dumping body.



Baltimore's motor truck, with radio equipment, for keeping in touch with the "trouble crew."

Front-drive Tilting Tractor

A NEW front-drive electric tractor has made its appearance which is particularly adapted for the lumber business. It is driven and steered by two wheels with an electric motor in each wheel driving at a single 25 to 1 reduction in balanced action at the periphery of the wheel.

The tractor frame extends back of the battery box about 5 feet, and the two ends of this frame are beveled upward. Metal pockets are placed underneath the floor of each of the trailer wagons, having end openings flared both downwardly and horizontally.

In the lumber business, one tractor serves from three to six trailer wagons, according to the length of the hauls. The trailer wagons retain the upper half of the original fifth wheel in front. During the operation of loading, the ordinary front axle construction is used with horses hauling the load. Half of the fifth wheel is used, in connection with horses to drag the wagon to and fro to be loaded. After loading, the wagon is placed in some convenient spot, and a horse or jack put underneath the perch, and the front axle removed. It is then ready for the trailer to couple on.

The tractor when detached is supported by its front driving wheels, and two small rear auxiliary wheels. All four wheels are mounted on springs. The flared ends of the trailer pockets being cornucopia shaped, are very easy to engage. When the beveled ends of the tractor frame strike the lower part of the front incline of the pockets, the tractive power of the front driving wheels pushes the rear frame extension up the incline of the pockets and back into position. The small auxiliary rear wheels of the tractor are then about 6 inches from the ground. An ordinary hook coupling with turn buckle is used on each side to firmly couple the tractor and trailer together. The operation of coupling and uncoupling a trailer is quicker than the same performance with horses, or ordinary tractors. When the tractor is detached, the center of gravity is placed well back of the front axle and enough weight is on the small rear wheels to preserve the stability of the machine. However, in case a reckless operator should stop too suddenly, going down grade, or be brought up by a deep hole, stump, or curb, any tendency to tip forward is taken care of by the rounded pair of skids brought down under the footboards in front.

The battery is placed on top of the frame back of the driver's seat, and is readily removable in a single unit by means of an overhead chain hoist and rail. In the lumber business, the hauls are long, and the loading and unloading very quick, so that high mileage with a tractor is possible. Two batteries are, therefore, furnished with each tractor, changeable at noon. The device has a capacity of three tons pay load, and speeds of from 6 to 8 miles per hour, which in the lumber business are the economical speeds. It is also made to haul 5 tons at 5 to 7 miles per hour.

The driver's seat is equipped with spring cushions, and is placed low down on the front end of the frame, with dropped foot boards, enabling the driver to sit under the forward ends of the long sticks of timber; with a top and storm front to protect him from the elements.

The pockets for the tractor can be readily applied to almost any type of wagon, and the majority of the time usually spent in loading by hand saved.

Emergency Truck With Radio Equipment

FOR the purpose of maintaining the municipal conduit system, the Electrical Commission of the city of Baltimore, has had constructed a specially designed and equipped auto-truck which has recently been placed in service. The most unusual and interesting feature of the outfit is the wireless telegraph equipment, through the agency of which the department is able to keep in constant communication with its trouble crew, so that all emergency calls can be handled with the greatest dispatch.

The truck serves as a receiving station only. The antenna is suspended immediately under the roof of the car, and is made of about 425 feet of No. 14 stranded rubber-insulated copper wire, which was laced back and forth until forty wires were strung with a separation of 1 inch. The aerial is, therefore, inconspicuous and well protected.

A series of rigid tests has proved conclusively that the scheme is entirely practical and that excellent results can be obtained, without resorting to the employment of trained operators, through the aid of a simple code of signals. It has also been demonstrated that a direct earth connection is unnecessary, inasmuch as the iron framework of the chassis serves admirably as a counter-poise ground, thereby enabling the truck to receive while in motion. During all of the preliminary tests the truck never failed to intercept any message sent to it within a radius of 10 miles of the sending station, and under the most unfavorable conditions, with the truck running at full speed and blanketed by tall buildings of steel construction no difficulty was experienced in reading the messages. A regular service is maintained between the truck and a 1-kilowatt station in the Commission's building.

Electric front-drive tilting tractor.

The tilting tractor coupled to a trailer loaded with lumber.

Motor Truck Notes and Queries

J. N. D. writes: "At what speeds could a three-ton truck be driven without inducing undue strain or wear on the different parts of the vehicle?"

A. Ten or 12 miles an hour under load is usually considered to be the safe speed of a truck of this size. In the case of fire apparatus, of course, such speed must be greatly exceeded, and as the engines, water towers, and hook and ladder trucks may represent a weight greater than a three-ton truck at full load, the vibrations induced would be excessive if the ordinary type of solid tires were used. For such purposes, therefore, pneumatic tires are almost universally employed, and with these a truck of the size that you mention may be driven at speeds from 15 to 25 miles per hour, provided the gear ratio has been properly designed. Many lighter delivery trucks that are run at speeds of from 15 to 20 miles per hour, are provided with pneumatic tires in front and with cushion or solid tires at the rear where the wear is greatest. Such trucks, however, are seldom larger than three quarters or one ton capacity.

N. A. E. writes: "I understand that the leaf springs of a truck should be lubricated occasionally. How is this best done, and what kind of lubricant should be used?"

A. The leaf springs of a truck or pleasure car are too often neglected by the owner or chauffeur. With each deflection and rebound of these springs, portions of the individual leaves are subjected to a sliding motion. Furthermore, water may occasionally find its way between surfaces of adjoining leaves, and the rust that will accumulate will add to the friction and resulting wear. A heavy oil or light grease, to which has been added a sufficient amount of graphite to make a black paste, serves as a satisfactory spring lubricant, and may be applied after the leaves have been separated, by means of a thin knife blade. The easiest way to separate the leaf springs is to jack up the car from the body so that the weight of the wheels and axle is suspended from the springs. However, if you desire, you can obtain one of the several spring wedges that are on the market, and which serve to separate the individual leaves of springs by means of a clamp and wedge arrangement.

P. L. K. writes: "I noticed a reply to an inquiry recently in which you mentioned a new method of burning carbon from the cylinders of a motor. Please describe the theory more in detail, and explain why the intense heat does not injure the motor."

A. The free carbon found in the interior of a motor is not combustible under ordinary conditions. As you doubtless know, however, oxygen is a supporter of combustion and materials that cannot be ignited in the open air will burn fiercely in free oxygen. Therefore, by introducing an especially designed blow-pipe, connected with an oxygen tank, into cylinders of a motor, and applying a torch, the carbon will be burned completely, and combustion will continue until the cylinders are absolutely clean. When the carbon has been consumed the flame, of course, dies out, for oxygen is not inflammable, and is merely a supporter of combustion. When the carbon is burned from the cylinders it is necessary to make certain that the piston is at the top of its compression stroke, when both valves will be closed. It is, furthermore, necessary that the circulating system should be full of water so that the heat generated by the burning process will be more easily dispelled.

G. D. N. writes: "What is the simplest method for determining the approximate horse-power developed by the 4 by 5 motor in my truck?"

A. Probably the simplest method for determining the approximate horse-power developed by a motor is what is known as the S. A. E. formula, which states that the horse-power of any motor is equal to the square of the bore, multiplied by the number of cylinders, and divided by 2½.

This formula is used for determining the rated horse-power of a motor as a basis for State taxation, but in view of the improved workmanship and better design of modern motors, it is no longer accurate. The piston displacement, or volume displaced by all the pistons during each stroke, should determine in a fairly accurate manner the power capabilities of the motor in question. Some manufacturers claim one horse-power for each 5½ cubic inches of piston displacement, while others are more conservative, and consider one horse-power to be obtained from each 7 cubic inches of piston displacement. We could probably obtain fairly accurate results by assuming that the modern pleasure car motor delivers a horse-power for each 6½ cubic inches of piston displacement, and the truck motor, because of the more careless handling to which it is subjected and less efficient conditions under which it must be operated, delivers one horse-power for each 7 cubic inches of piston displacement. As the motor of your truck would have a piston displacement of 252 cubic inches, you will see that the approximate horse-power developed by it, by the application of the above method, is 36.

The United States Battleship "Pennsylvania" and Class

(Concluded from page 244.)

of the forward turret. On the main deck aft are two three-gun turrets, similarly disposed. This gives a concentration of six guns ahead, six astern, and a broadside fire of twelve guns.

The three guns in each turret are mounted in a common sleeve and are elevated, trained, and fired as one gun. This greatly assists the spotter in locating the fall of the shots and making the corresponding corrections in the elevation. Moreover, it effects a considerable saving of weight.

An excellent feature is the great height at which the amidship battery of 5-inch, torpedo-defense guns is carried. There are twenty-two of these guns in all. Four of these are mounted in casements on the main deck forward; four in casements on the gun deck aft; ten in a central battery on the forecastle or spar deck, and four on the boat deck above the central battery. This arrangement gives a concentration of eight 5-inch guns forward and aft and eleven on each broadside.

The armor protection is unusually extensive and of greater weight and thickness than that of any ship under construction for other navies. The belt armor will have a maximum thickness of not less than 14 inches, and the gun positions will be similarly protected, the front plates of the turret being 18 inches thick, the protection of the barbettes being in proportion. The water-line belt will extend over eight feet below the water-line, and the whole side of the ship to the main deck will be heavily armored. With the side armor will be associated heavy transverse armor bulkheads and several horizontal armor decks.

The battery of water-tube oil-fired boilers will be contained in a set of separate, heavily bulkheaded boiler rooms, extending clear across the ship and served by a single smokestack, the base of which will be protected by heavy inclined armor, this to protect the uptakes against penetration, and thereby prevent the furnace gases from passing into the 'tween decks, as happened, disastrously, to the Russian ships in the battle of Tsushima.

The dimensions of the ship will be as follows: Length on water-line, 600 feet; length over all, 624 feet; breadth, 97 feet; draft, 30 feet; displacement, 32,000 tons. She will be provided with four submerged 21-inch torpedo tubes, and her complement will consist of 1,056 officers and men.

The cost of the ship, exclusive of armor and guns, will be $7,800,000, and the ship when complete will have cost about $15,000,000. She was laid down in February, 1913, and is due for completion in February, 1916.

The "Pennsylvania" will be turbine-driven and her contract speed is to be 21 knots.

War Issue No. 2
of the
SCIENTIFIC AMERICAN
OCTOBER 3, 1914

For Sale by all Newsdealers

Price 25 cents

Cover in four colors, two page insert of German Fleet in the North Sea, with Zeppelins in the Sky. There will be nearly 100 illustrations. In connection with the War Number of September 5th, it will form a most valuable handbook of the War.

Many illustrated articles will tell in a simple yet graphic way how modern turret forts are constructed and how they are besieged; how defenses are thrown up in the field and how barbed wire, felled trees and other obstacles are employed to thwart attack; how great siege guns are used in battering down a fortress; in a word how science and engineering play their part in modern warfare.

DAY after day the Germans pumped shot and shell upon the fortifications of Liege. But the forts held out bravely. "Wait until our heavy siege artillery comes," said the Germans. When it came, the forts crumbled.

They must have been very wonderful forts that could hold out so dauntlessly, and they must have been very wonderful guns that ultimately reduced them. In the October 3rd issue of the SCIENTIFIC AMERICAN you will learn all about these forts (there are many more like them along the French-Eastern frontier), and all about the big guns that cracked them.

The Gruson Turret Fort

Military men call these Liege defenses and others of their type "Gruson Turret Forts." Curiously enough they are of German design, and fittingly enough it took German guns to reduce them.

Major A. Piorkowski, a well-known German expert on ordnance, has written, for the October 3rd issue of the SCIENTIFIC AMERICAN, a very instructive article on this Gruson Turret Fort. He takes you by the hand, as it were, and leads you through underground passages to the ammunition hoists, and eventually into the steel turret itself, and shows you its operating mechanism and its powerful weapons.

Huge Siege Guns of the Germans

The huge siege guns before which the turret forts succumbed will receive their attention in another article. In a magnificent colored cover, which will enclose the entire issue, one of these destructive giants is pictured in action. The issue will also present other pictures of siege artillery, and will explain in the SCIENTIFIC AMERICAN's characteristically lucid way what may be expected of them.

Fortifications in the Field

How was the German onslaught met in pitched battle? Defenses of some kind, as well as gun fire, were necessary. Every obstacle that can be conceived was thrown into the path of the onrushing German infantry. The barbed wire fence and felled trees with great protruding branches must have proved formidable barricades. The full nature of these defenses, which make it as necessary for an infantryman to carry wire cutting tools as guns, will be set forth.

Submarine Mines and How They Are Constructed

Perhaps a dozen or more neutral merchant vessels have been blown up by mines in the North Sea. They are terrible instruments of destruction, these mines. A tramp steamer, or a battleship for that matter, steams along through a sea that betrays nothing of the explosives hidden beneath its waves. Suddenly the ship's bottom touches the top of the mine. It is as if the trigger of a gun loaded with hundreds of pounds of deadly explosives had been pulled. The explosion is terrific; the destruction complete. How are these mines constructed? Why are they so deadly? The SCIENTIFIC AMERICAN's war issue No. 2 will tell.

The Mechanism of a Submarine Boat

The submarine boat will also receive its share of attention; for the submarine is bound to play its part in the present conflict. As you read the SCIENTIFIC AMERICAN's article on submarines, their intricate mechanism will be picked apart for you, as it were, just as if they were so many watches. Engines, trimming tanks, periscopes, torpedo tubes, in a word, all the wonderfully compact machinery of the submarine will be revealed.

There will be other articles too, in this issue—articles of a constructive nature.

Our Trade Opportunity

John Barrett, director of the Pan-American Union, will point out to the American exporter just what the war has done for him in opening up foreign markets that have hitherto been closed to Americans. Letters from prominent financiers, business men manufacturers, will also be published—all of them men worth heeding—whose opinions will form a fitting supplement to Mr. Barrett's exposition.

Cadillac Standard of the World

The Eight Cylinder Cadillac

Eight power impulses in every cycle—overlapping so completely that they melt and merge, one into another, in a steady flow of power

This is the story, in a single sentence, of the Eight-Cylinder Cadillac.

Complete continuity—not theoretical, but actual.

You can figure the effect of this overlapping of power impulses as well as we can describe it.

You can imagine it, that is,—from what you know of comparative or approximate continuity.

But your imagination will fall very far short of the facts.

You have never had a ride such as your first ride in the Eight-Cylinder Cadillac will be.

You have doubtless discerned that different types of motors produce different sensations in riding.

But none of these differences are so pronounced as the difference which exists between this Eight-Cylinder motor and all other types.

When scientists and mathematicians cannot carry a calculation to a higher, or to a finer point, they say it has reached the n^{th} degree.

This Eight-Cylinder Cadillac carries the principle of continuous power to the n^{th} degree.

It produces eight power impulses during each complete cycle; four power impulses during each revolution of the fly-wheel—one every quarter turn.

What follows is not merely a revelation—but actually a revolution in riding results.

It is infinitely more than a matter of simply furnishing greater power.

It is the velvety way in which that greater power is furnished by the Eight-Cylinder Cadillac which overturns all your previous conceptions of motoring.

We said in the caption that the impulses overlap so completely that one melts and merges into another.

That is literally true.

We said that this produces a steady flow of power.

That is also literally true.

But this is only a part of the truth—and a very small part.

The power ebbs and flows so flexibly that the car can be operated almost continuously under throttle control, without change of gear.

The steadiness of its application imparts a like steadiness to the car itself.

After your first ride in the Cadillac Eight you will revise your idea of what constitutes freedom from vibration.

You will revise your idea of efficiency at high speed; and of efficiency at low speed.

When you climb a hill you scarcely feel as though you were climbing a hill at all.

You will be more apt to feel, instead, that the hill has accommodatingly subsided into a level roadway.

The fluid flow of uninterrupted power gets better riding results out of all kinds of roads.

If the road be level, and good, the Cadillac Eight extracts from it a new and a superlative smoothness.

If it be rough and uneven, the steady, unbroken torque minimizes the jolts and jars.

The motor does not seem to be driving the car, but rather to have given it wings.

It is difficult to treat the subject in calm and temperate terms in view of the impressive fact that this Eight-Cylinder Cadillac has created a new kind of motoring.

We can see nothing ahead but a demand so overwhelming that it will be impossible for the Cadillac Company, within a year, to satisfy that demand.

Styles and Prices

Standard Seven passenger and Five passenger cars, Four passenger Salon and Roadster, $1975. Landaulet Coupe, $2500. Five passenger Sedan, $2800. Seven passenger Standard Limousine, $3450. Berline type Limousine, $3600. Prices F. O. B. Detroit.

Seven Passenger Touring Car (illustrated) with Eight Cylinder V Type Engine.

Observe that the Power Plant does not demand a hood of abnormal proportions.

Dealers will have demonstrating cars in the near future

Cadillac Motor Car Co. Detroit, Mich.